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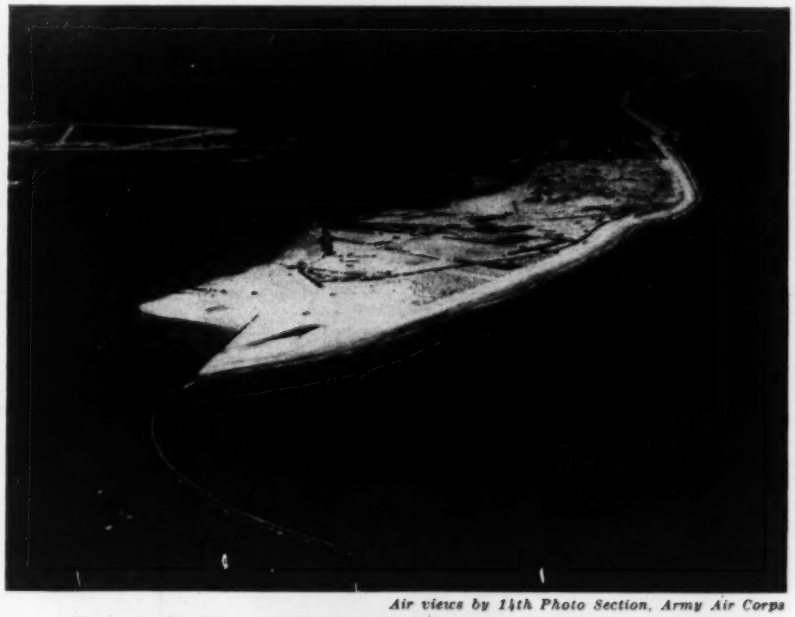
Rockaway Point Jetty Stops Sand Drift in New York Harbor

Jetty 8,600 ft. long of huge stone blocks built upon recommendation of special army board for protection of Jamaica Bay inlet and general harbor

A HEAVY rock jetty 8,600 ft. long, sweeping southward on a long curve off the western tip of Rockaway Point, New York harbor, is being built by the U. S. Engineers for the protection of Jamaica Bay inlet and to stop a persistent westward drift of sand into New York harbor. Started late in 1930, the work will be completed this spring. In the 2½ years that have elapsed since start of construction a considerable beach has been built up on the east side of the jetty, an indication that the structure will satisfactorily serve its intended purpose.

The location of the jetty is shown on the map, Fig. 2. Rockaway Inlet, the entrance to Jamaica Bay, lies between Rockaway Point on the south and east and Coney Island on the north. Plans have been in existence for years for the development of Jamaica Bay as an industrial and marine terminal area. Development is cooperative between the federal government and New York City, the government's contribution to the work being dependent upon certain obligations to be carried out by the city. The city has fulfilled some of these obligations in the building of piers in the Canarsie section of Brooklyn. The government is to maintain a 30-ft. entrance channel, 1,500 ft. wide, from deep water to Barren Island. From Barren Island to Cornell basin a 30-ft. channel 1,000 ft. wide will be dredged and maintained cooperatively by the city and government. At present this channel has been dredged between Barren Island and the Canarsie piers.



Air views by 14th Photo Section, Army Air Corps

Fig. 1—Sand building up behind jetty, Rockaway Point, N. Y. View shows jetty about half completed. Sand fill today extends well into curved section of jetty. Barren Island and Floyd Bennett airport may be seen in upper left background.

The Jamaica Bay development, of which the Rockaway Point jetty is a part, was authorized by the River and Harbor Act of June 25, 1910, which appropriated $258,500, not to be expended, however, until the Secretary of War was satisfied that the city of New York was prepared to undertake its part of the general plan for the improvement of Jamaica Bay. Also the River and Har-

bor Act of Sept. 22, 1922, provided for further improvement in the bay, including the entrance channel "whenever and to such extent as the city of New York shall construct or provide for the construction of terminals with facilities suitable for channels of that depth."

The westward drift of sand along the south shore of Long Island has been recognized for years. In 1923 an experimental channel was dredged at the entrance of the proposed inlet channel into Jamaica Bay. Subsequent surveys of this dredged channel showed an encroachment of sand on the easterly side accompanied by a westerly migration of the channel, proving conclusively that an unprotected entrance channel was undesirable.

The primary purpose of the jetty that has now been built is to arrest and impound sand moving down the coast line. It also serves as a breakwater for protection of shipping entering Jamaica Bay, especially at the outer end of the channel. It will concentrate and direct the currents that have formed in the present bar channel and will also prevent the opening of the swash channel through the bar close to the shore and end the heavy shoaling on the outer part of the bar channel that is to be anticipated if such a swash channel should open. The jetty was curved on the theory that it will impound more sand than a straight-line jetty and will direct the currents better. At first it was felt that it might be necessary to build a jetty on the west side of the entrance channel, which would have meant a structure 11,000 ft. long, but subsequent studies revealed that it was not required.

Fig. 2—Map of New York Harbor, showing location of new Rockaway Point jetty built to stop persistent westward drift of sand into the harbor.

In connection with the Jamaica Bay development, a special board was appointed by the Chief of Engineers, U. S. Army, to study the movement of the sand entering New York Harbor. The board consisted of five army engineer officers and two civilians, as follows: Col. W. J. Barden, Col. G. M. Hoffman, Col. G. B. Pillsbury, Lieut.-Col. J. Dent, Major B. D. Somervell, Prof. E. W. Johnson and Prof. Thorndyke Saville. The general findings and recommendations of the board for the Jamaica Bay developments are given below.

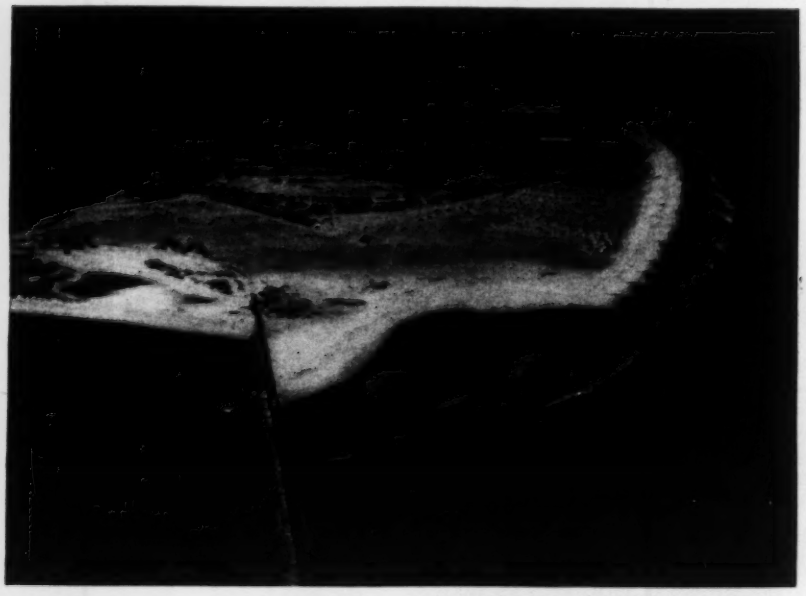


Fig. 3—Sand started to build up soon after start of work on jetty. View shows trestle used for construction purposes in early stage of work.

There has been a general westerly growth of sand spits all along the south shore of Long Island from Southampton on the east to Coney Island on the west. The easterly 30 miles of the south shore of the Island is made up of headlands of gravel deposits left by glaciers. Sand along the beaches, under the influence of waves from the east and southeast, is rolled diagonally up the beach, then retreats seaward down the beach slopes to be picked up again by oblique wave action. This constant zig-zag motion results in a steady movement of sand particles toward the west. Material in water too deep to be carried along by wave action is somewhat disturbed by oscillatory movement set up by the waves. Observations of divers show that wave action will disturb sand to a depth of 50 ft., and currents in such depths will move sand along the bottom. Observations also show that strong gales accelerate sand movement. The south shore of Long Island is protected from gales in all directions except those coming from the southeast quadrant. The resultant sand movement caused by gales is therefore to the west. At bay inlets the sand movement is more complex and pronounced. Flood tides cause currents that carry sand. Upon entering into quiet waters of bays these currents are retarded, resulting in depositing of sand and formation of shoals.

At Rockaway Inlet the growth of the spit has deflected to the south, and a large outer bar has been formed. Since 1835 the shore line of Rockaway has been extended 4 miles to the west and push to the south, though there has been little building up of the spit since 1921. It is estimated that the volume of sand in accretion at the point between 1902 and 1928 is 5,500,000 cu.yd., or 200,000 cu.yd. annually. The primary source of this sand is the headland section at the eastern end of Long Island. There is little evidence of sand movement from a westerly source.

While Rockaway Point has, at least temporarily, stopped growing, movement of sand past the point has not stopped. This sand would render unstable any unprotected entrance channel into Jamaica Bay. Sand moving past the point is deposited in part in an area off the point to the north and east of Ambrose channel (main ship entrance to New York Harbor), and in part is swept into Jamaica Bay, while a very small part piles up on the point. It is estimated that at the time the studies were made the total amount of sand entering the harbor from the east was 1,800,000 cu.yd. per year.

The movement of sand and erosion of the beach along Rockaway Point has in the past caused considerable damage. The city, government and private owners have protected the various beach properties by building numerous groins. Coney Island is also affected by western movement of sand. There is a narrow navigation channel along the south edge of the island that is difficult to maintain because of sand filling.

As a result of these findings, the board recommended the building of the

Rockaway Point jetty. It was found that the extreme western tip of the point was stable enough for the root of such a jetty. The board estimated that sand would be piled up 9 ft. above mean low water. On this basis the jetty would impound about 32,000,000 cu.yd. of material. It was estimated that a time of 60 years would be required for completely filling the area behind the jetty, though opinions now are held by some that this time may be cut to as short as fifteen years.

The board recommended a jetty built to a height of 9 ft. above mean low water, with a top 10 ft. wide and side slopes of 1:1, except that on the outer arm the top width should be increased to 15 ft. and the side slopes flattened out to 1½:1. It was recommended that the jetty should be located not less than 500 ft. from the near side of the proposed channel. This proposed jetty, 8,600 ft. long, would reduce the width of the entrance to New York Harbor, between Sandy Hook and Rockaway Point, by about 10 per cent.

Design of jetty

The jetty extends almost due west of the point for a distance of 2,200 ft., then sweeps southward for 1,600 ft. on a curve of 2,500-ft. radius and extends due south for an additional 4,500 ft. The structure as built consists of a core of small stone covered by large slope and capstones. The first 4,100 ft. of the jetty is designed with a 10-ft. top and 1:1 side slopes built 10 ft. above mean low water to allow a settlement of 1 ft. The remainder of the jetty is built with a 15-ft. top, and side slopes are 1½:1. Extending for a distance of 500 ft. beyond the end of the jetty is an apron of small stones to protect the end of the jetty from scour.

The core is made up of stones weighing not less than 135 lb. per cu.ft. dry in air, and consists of a graded mixture of quarry-run stone, the pieces ranging in weight from 15 lb. to 6 tons. Twenty-five per cent of the core is in pieces ranging in weight from 15 to 200 lb., and the remainder is in pieces from 200 lb. to 6 tons. No flat slabs or rounded boulders are allowed. Slope and capstones are specified to weigh not less than 160 lb. per cu.ft. dry in air. The pieces are required to be angular with the least dimensions not less than one-third the greatest dimension and must weigh at least 6 tons. The jetty will contain about 475,000 tons of rock, of which 35 per cent represents the larger cap and slope stone.

Construction

Specifications permitted dumping of the corestone in place, but required that the side slope and capstone be carefully placed by derrick. All stone was delivered to the job in barges, the smaller stone coming in part from traprock quarries in Connecticut and in part from rock excavation of New York's new

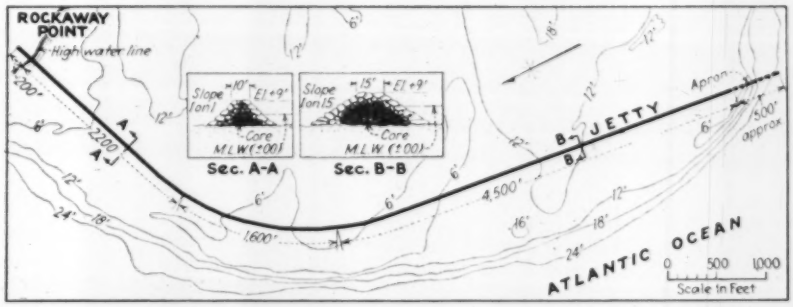


Fig. 4—Contours of ocean bottom along line of jetty at start of work. Water averaged 6 to 12 ft. deep below mean tide, though it became deeper at outer end. Inserts show cross-sections of jetty. Smaller section was used for first 4,100 ft.

Hudson River piers. Most of the slope and capstone came from granite quarries in Maine. A timber pile trestle carrying a railroad track was built along the line of the proposed jetty. Much of the corestone was transferred from barges to standard dump-cars by derrick boats at a pier near the root of the jetty and then was hauled out over the trestle to be dumped directly in place. Last November, when the jetty was about two-thirds complete, a severe storm carried away 700 ft. of the seaward end of the trestle and tore off much of the remaining deck and track work. Rather than replace the damaged trestle, the contractor elected to finish the job by depositing the remaining corestone direct from barges with the aid of floating derricks.

All of the capstones and side-slope stones were carefully set by derrick boats. The largest of these stones handled is estimated at 27 tons. As contract payments are based upon weight of stone placed, every barge was calibrated so as to determine the weight of the barge load by displacement in the water.

As can be seen from the map (Fig. 2), the jetty extends directly into the Atlantic Ocean without the protection of any near-by land. The site of the work is exposed to easterly, southerly and westerly wave action and to ocean storms and currents. In addition to the normal storm and tide currents, the building of the jetty created a strong current along its east side and around its end, which often hampered the floating equipment.

Contractor and personnel

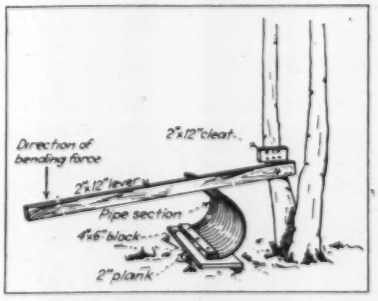
The jetty is being built under the U. S. Corps of Engineers, 1st New York District. Col. G. R. Lukesh is district engineer and is responsible for the work. A. E. Clark, assistant to the district engineer, is in direct charge of construction for the government. Contracts for the work, estimated at $1,800,000, are held by the Merritt-Chapman & Scott Corp., of New York City. George Burrows is construction manager for the contractor, and Tim Killen is superintendent in charge.

Correcting Distorted Pipe-Culvert Sections

By F. R. Molther
Ancon, C. Z.

PIPE-CULVERT sections that have been distorted in handling can be opened, if the diameter has been reduced, by dropping or throwing them on the ground so that the convex or round side hits the ground first.

Timber lever rigged up to facilitate reshaping of distorted culvert sections.



Sections of small diameter and light gage can be closed by pushing the edges together by hand. For sections of large diameter or heavy gage, additional power is required, such as a lever rigged between two trees, as shown in the accompanying sketch, with one man to guide the lever, another to move the pipe, so that the lever may be applied at each end and at the center of the section, and four or five men to exert the bending force on the lever. With this device all distorted sections can be easily and quickly bent to the exact diameter; in using some kinds of culvert pipe, the device is useful for assembly. Sections of small diameter and light gage also can usually be bent more efficiently and precisely by this method than by hand. Of course, where trees are not available, or not suitably located, a simple frame might be built to furnish the same results.

Structural Changes in Building Alterations

Two jobs in New York City afford examples of the type of work required to improve working quarters and show-window facilities

BUILDING MODERNIZATION promises to provide one of the most active fields for structural engineers in the next year or two. Much of this alteration work is strictly architectural and mechanical, but provisions for such improvements as enlarged entrances, lobbies and office space, better show-room facilities and improved elevator service are usually dependent upon structural changes. Some of these, as evidenced by recent examples, present problems of major importance. —EDITOR.

TWO building-alteration jobs that were completed in New York City during the past year emphasize the important part that structural changes play in work of this character. One job resulted from a new building addition, which necessitated removal of the lower part of some columns in the center of the old building and the extension of some wall columns downward to permit elevators to reach a sub-basement. On the other job it was required to replace two cast-iron columns with a single steel column in a store front, to improve show-window space.

Banking-room improvement

Late in 1931 the Bankers Trust Co., in New York, let contracts for the enlargement of its tower building, at the northwest corner of Wall and Nassau Sts., which for twenty years has been one of the landmarks of the financial district. A new building, twenty-five stories above the street and four below, was constructed on the north and west sides of the old building, more than doubling the available floor space. Improvement of the banking room on the first floor of the old building to make it an integral part of the new banking room necessitated extensive alterations. The new building was placed in operation on April 10, 1933.

The scope of the operations is shown in Fig. 1. The entrance to the old building is on Wall St., between cols. 2 and 4. The bay marked by cols. 28, 29, 26 and 31 is occupied by a wide flight of steps leading directly into the main banking room. It was desired to eliminate col. 35 in this room and col. 14 in the old north wall, giving a clear span of 33 ft. between cols. 36 and 34 and cols. 15 and 13. This width of bay was carried through the new addition to Pine St.

As shown, col. 35 was removed between the third floor and the basement by inserting a truss between the fifth

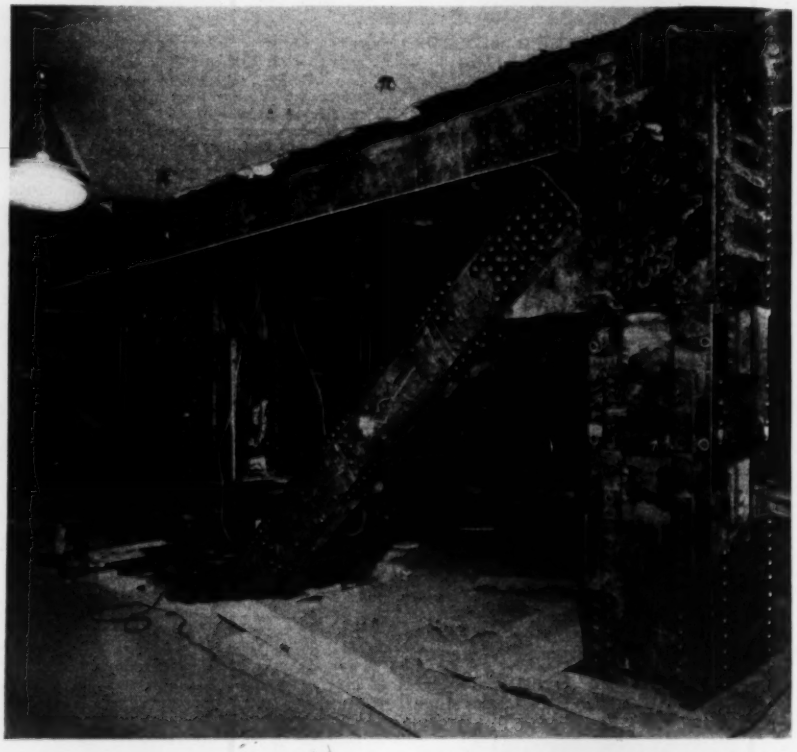
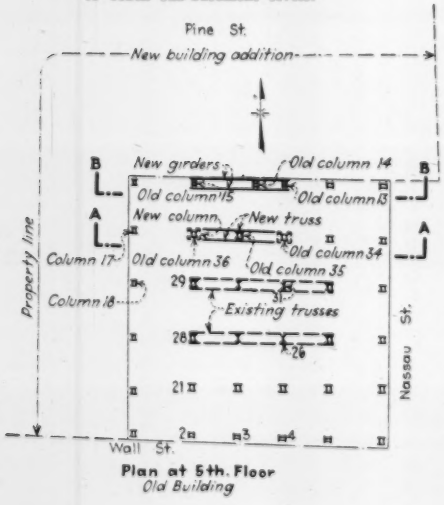
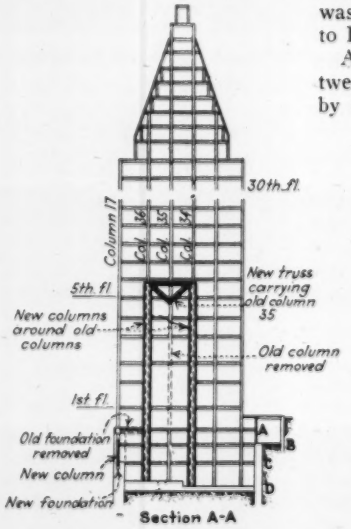
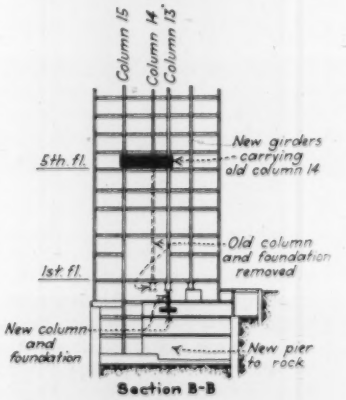


Fig. 2—Truss inserted in fifth floor picked up col. 35, permitting the removal of its lower portion. Note that columns supporting the truss are built around and separate from existing columns.

Fig. 1—Alterations to the tower building of the Bankers Trust Co., which were made necessary by a new 25-story addition on the north and west sides. Cols. 14 and 35 were removed in lower stories to open up the old banking room to the 33-ft. width provided in the new building. Cols. 17 and 18 extended downward to permit elevators to reach sub-basement levels.







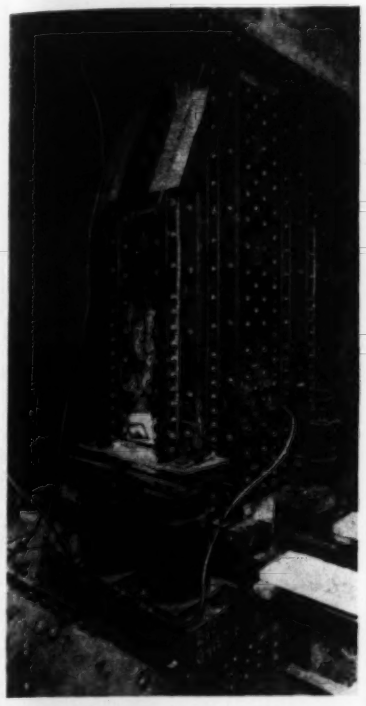


Fig. 3—Jacking arrangement for transferring the 940-ton load on col. 35 to the truss. Four 300-ton hydraulic jacks were used between an 8-in. billet bearing on the truss and heavy brackets riveted to the column.

and sixth floors to carry the part of the column above. The lower part of col. 14 was removed by using a girder in the fifth story.

Col. 35 carried a load of 940 tons at the third-floor level. The transfer of this load to the truss was a major operation. Existing cols. 34 and 36 were not large enough to carry any additional load, and strengthening them sufficiently would have been difficult. Accordingly, new columns, about 150 ft. long, were built around the old columns to serve as truss supports. These columns, made up of four 8x8x1-in. angles, four 8x8x⅝-in. plates and batten plates, were extended to the old footings, which were large enough to carry the additional load. Large gusset plates shop-riveted to the top of the columns in the shop afforded connections from which the chord and diagonals of a triangular truss could be hung.

With the columns in place and the truss assembled, the jacking arrangement shown in Fig. 3 was used to transfer the load of col. 35 to the truss. Diaphragms built into the apex of the truss together with the gusset plates supported two 26x8-in. billets upon which four 300-ton jacks were installed. Heavy brackets were riveted to col. 35, and by jacking against these brackets the load was transferred to the truss. Steel wedges 9 in. wide were driven between the brackets and the 8-in. billets to carry the load permanently, and then the jacks were removed.

Installation of the girder to carry col. 14 was carried out in a similar manner, although in this instance cols. 15 and 13 were adequate to carry the additional load when relieved of the wall load that they had previously supported. The 9-ton girder presented a larger erection piece than did the truss members, and in this respect its installation was more difficult. The load transferred was 600 tons.

Numerous other alterations were necessary. To comply with the architectural requirements of the new building, it was necessary to remove entirely basement A of the old building and erect a new floor at a lower level. A large part of the first floor was changed. A new mezzanine floor was formed by removing part of the old second floor, the old mezzanine floor was removed, and a complete new second floor was substituted. Where passageways were made between the old and new buildings the tops of the windbracing girders in the north and west walls projecting above the finished floors had to be reinforced and cut down. Certain elevators along that west wall that stopped at the first floor were run down two more floors. This necessitated the underpinning of existing cols. 17 and 18. Transfer of the load was then made by means of wedges, as shown in Fig. 4. In some cases the wedges were operated by screw jacks, but in others air rams were required.

As shown in Fig. 1, the bottom of col. 13 was also extended to a lower level. This underpinning was required in order that the foundation wall between the old and new buildings might be removed, and incidentally to permit connection of the lower basement levels of the new addition with the old building. It was carried out by a procedure similar to that shown in Fig. 4 for cols. 17 and 18.

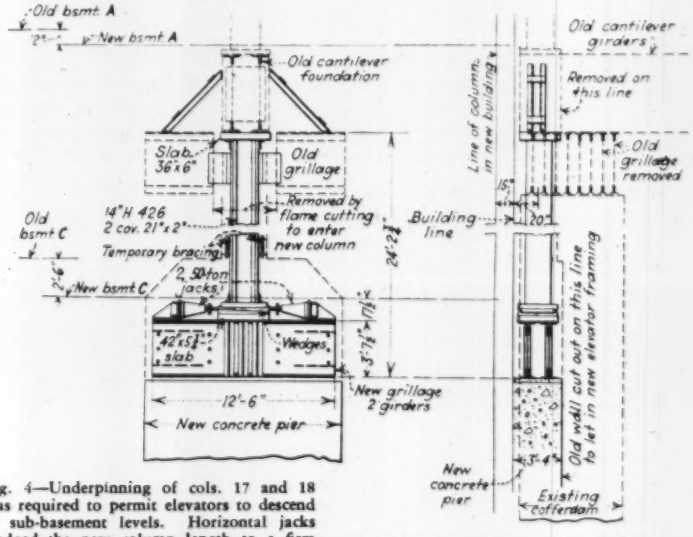


Fig. 4—Underpinning of cols. 17 and 18 was required to permit elevators to descend to sub-basement levels. Horizontal jacks wedged the new column length to a firm bearing under the old column.

All of the alterations were carried on while the old building was fully occupied above the seventh floor. No sagging of floors or cracking of ceilings or partitions occurred. The architects were Shreve, Lamb & Harmon; the engineers, Purdy & Henderson; the general contractor, Thompson-Starrett Co.; and the steel contractor, Post & McCord.

Better show-window space

Modernization of the Herald Square Hotel on 34th St., New York, was carried out in order to provide more desirable and valuable facilities. The second floor was reconstructed into a restaurant, and along the street front of the ground floor such structural changes were made as would create a revenue-producing shop installation. At the junction of the main building with its eight-story addition (Fig. 5) the presence of two cast-iron columns, quite close together, on account of one being in the side wall of each building, presented an objectionable obstruction in the show window space of two adjoining stores. The solution was to substitute a steel column for the two cast-iron columns. A pair of steel girders placed on top of the steel column picked

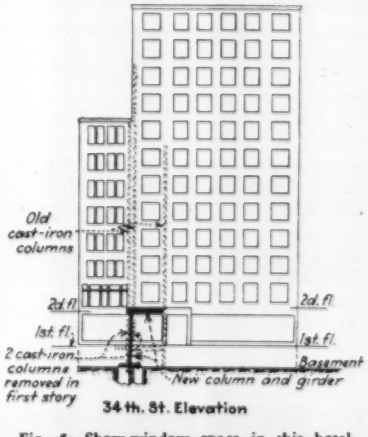


Fig. 5—Show-window space in this hotel building was improved by substituting a slender steel column for two heavy cast-iron columns.

up the load of the two cast-iron columns at the second floor. Since the steel column was concealed in the partition between the adjoining stores, all obstruction in the show windows was removed when the two cast-iron columns were cut off at the bottom of the girders.

The architects were Necarsulmer & Lehlbach. Matthew Hiller, Jr., was engineer; Cornelius Callaghan, Inc., general contractor, and Post & McCord, steel contractor.

* * * *

Modernization of Facilities in a Cleveland Hotel

Method of organizing and scheduling work for rearranging and renewing mechanical plant and facilities of an eleven-story hotel

By R. P. Wallis
Expediting Engineer, Lundoff-Bicknell Co., Cleveland, Ohio.

BUILDING modernization is often wholly a task of rearranging interiors and renovating the mechanical facilities without change of structure or architectural appearance. The operations described in this article are in this class. That such modernization work does not fall into the small-expenditure class is indicated by the renewal and repair bill of $700,000 for the work described. Renovation of facilities and services, however, requires a special kind of management and scheduling procedure which the following account clearly sets forth. The article is a recital of detail, but the operation is one of detail, and circumstantial description cannot well be avoided. —EDITOR.

IT IS BECOMING more and more evident that modernizing and renovating are to play an increasingly greater part in building programs. There is nothing new in this phase of building activity. The alteration of structures for one reason or another has always been an integral part of the construction business. Its cogent appeal today lies in the possibilities of economic relief offered to owners burdened with vacant and depreciated property.

There is little basic difference between various types of building operation. Identical groups of mechanics find employment, and the same materials of construction are everywhere utilized; there exist, however, certain fundamental differences of technique peculiar to each type.

New construction is generally far less complicated in its requirements. A builder is faced only with a site and a completion date. In remodeling, however, the builder may find himself constrained to live with an owner during the construction period, paying strict attention to his convenience and respecting his every whim. Furthermore it is often impossible for the designer correctly to delineate the extent of revision. It is sometimes difficult to determine just how much of the original structure may be utilized until the contract is signed and demolition is well under way. Information may thus come to the builder in driblets, complicating the purchase of labor and material. In the field, no one operation may be regarded as independent of the rest. Each must be undertaken at the most propitious moment, not only from the viewpoint of the builder but from that of the owner.

Better to illustrate the exacting requirements of this type of construction, some of the problems encountered in the rehabilitation of the Hotel Winton in Cleveland, Ohio, are outlined.

Old condition and new plan

Late in 1931 the hotel fell a victim to the depression, passing into the hands of the holders of the first mortgage. The immediate concern of the new owners—a large insurance company—became the rehabilitation of the property in order that it might quickly be disposed of and at a figure that would enable them to realize their equity.

The original structure (Fig. 1), completed in 1917, was eleven stories high and of reinforced concrete faced with brick and terra cotta. In the basement were the Rainbow Room, a number of private dining rooms and the attendant kitchen. The main or ground floor included the front office and lobby, the coffee shop, breakfast room, dining room and kitchen. On the mezzanine floor were the banquet hall and a number of parlors suitable for use as private rooms, sample rooms or offices.

The nine guest-room floors above, divided into 540 rooms and baths, were served by three 450-ft.-per-minute elevators. In addition to the passenger elevators, two freight and service elevators and a food hoist servicing the three lower floors were in operation. Between the mezzanine and second floor and between the tenth floor and roof were horizontal transfer spaces 5½ ft. and 3 ft. 7 in. in height, respectively, designed for the convenient distribution of pipe lines, ducts and other mechanical facilities to the individual riser stacks serving the guest rooms on the intermediate floors.

Deterioration of the mechanical equipment had progressed to the point where replacement became an economy. In addition to replacing the original steam, return and hot-water lines with copper tubing throughout the structure, the program called for a new all-electric kitchen on the main floor, mechanical ventilation in all of the restaurant, new 600-ft.-per-minute elevators and air-conditioning in the coffee shop.

Plan of operations

Separate contracts were let by the owner: a general contract embracing the mechanical and incidental general changes; a kitchen-equipment contract covering the furnishing and installation of ranges, refrigeration and so forth; a decorating contract for refurnishing the public spaces; and a number of separate contracts for furniture, rugs and light fixtures for the guest rooms.

The nature and character of the work

Fig. 1—Hotel Winton in Cleveland, Ohio, modernized by renewing mechanical equipment and renovating public and guest rooms and services at a cost of $700,000.

undertaken, particularly the mechanical items, was such as to affect every part of the structure. Furthermore, this work was to be undertaken at such times and in such a manner as not to interfere with the operation of the hotel. It was also necessary to carry on this work as economically as possible as only a limited budget was available. Accordingly as much of the original equipment as could be salvaged was required to be repaired and utilized.

Study of the requirements indicated that the undertaking might conveniently be considered as two separate group operations: those in the public space, basement, ground and mezzanine floors, and those in the guest-room floors above. It was further evident that work might be carried on in these areas more or less simultaneously. A progress schedule was accordingly prepared, dividing the work up by locations rather than by operations, as is generally customary. Thus on the main floor the various trades were scheduled separately under the headings of kitchen, coffee shop, ice machine room, office space, lobby and so on.

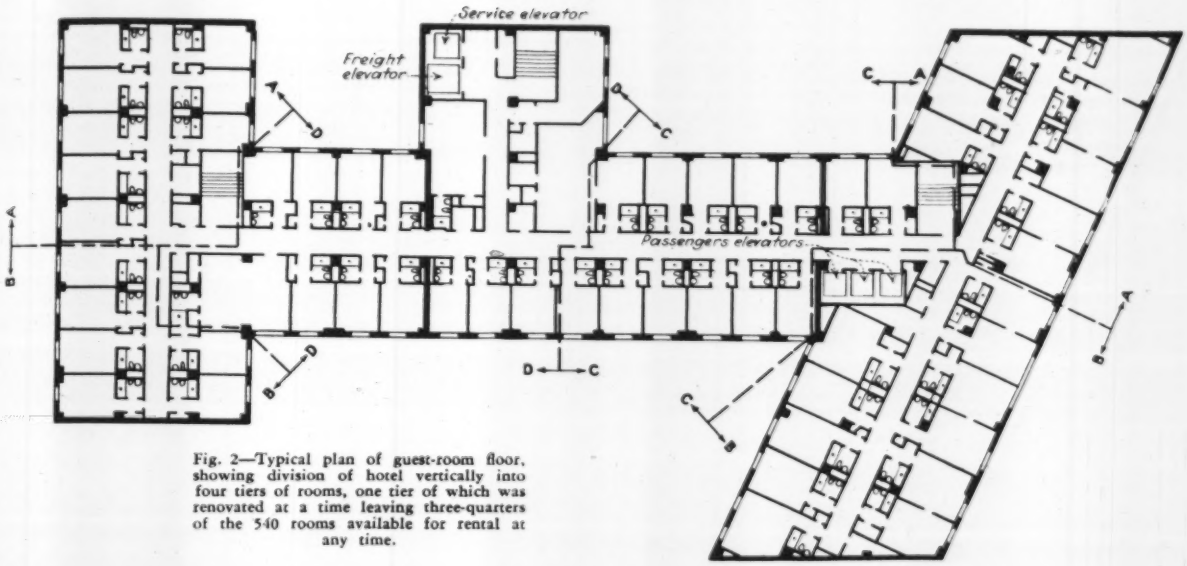


Fig. 2—Typical plan of guest-room floor, showing division of hotel vertically into four tiers of rooms, one tier of which was renovated at a time leaving three-quarters of the 540 rooms available for rental at any time.

The commencement of operations found the coffee shop and kitchen on the main floor in use as the principal restaurant facility, with the Rainbow Room and ball room available for special functions. Not to interfere with the serving of meals, it was decided to utilize the Rainbow Room in the basement as the principal restaurant during the reconstruction of the main-floor coffee shop and the adjacent breakfast room and dining room. It was first necessary, however, to install temporary fixtures in the basement kitchen and at the same time run all of the lines for the new kitchen above on the basement ceiling, stubbing up so that they might later be connected to the new kitchen equipment with the least possible confusion.

Upon completion of this preliminary work the main-floor restaurant facilities were shut down and the Rainbow Room was thrown open to the public for temporary use. In the coffee shop an extensive air-conditioning system was installed in connection with the ventilation, the walls and ceilings were completely redecorated, and a new floor was laid. In the kitchen area the cooking, dishwashing, refrigeration and storage facilities were centralized in one location. New equipment was installed, making it the first all-electric kitchen to be installed in any Cleveland hotel. A quarry tile floor was laid, and the plaster walls and ceilings were repaired.

Alterations in the remainder of the public areas were carried on one operation at a time so as to minimize the dirt and confusion. Worn marble tiles in the floor were cut out and replaced one by one. The stairs leading up and down from the lobby were to be carpeted, so the worn marble treads were removed and sufficient material was salvaged to serve as a border. A new porter's counter was constructed, utilizing as much of the original marble and wood paneling as was possible.

Upon completion of work in the coffee shop and kitchen these rooms were put into service and the Rainbow Room and basement kitchen were shut down for repairs and alterations, the latter becoming a servery for use in connection with the Rainbow Room.

Procedure in guest rooms

The installing of approximately 10 miles of new hot water and steam return lines on the floors above necessitated extending operations into each of the 540 guest rooms.

Hotel rooms are generally rated in price in accord with their desirability as to location as well as to their furnishings. Inasmuch as the lines to be torn out and replaced extended up the pipe shafts servicing the guest-room toilets and exterior-wall radiation, it was not practicable to shut down the guest-room area one floor at a time as it was, of course, necessary to disconnect the various lines during the construction period.

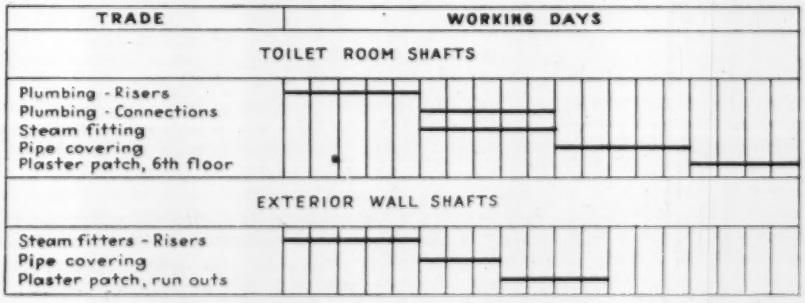
The guest-room floors were accordingly divided into four groups vertically as shown by Fig. 2. Only one group at a time was shut down so the management had at all times three-quarters of the rooms available for rental. Furthermore, this subdivision was arranged so that the management might at all times have at their disposal all types of rooms.

In considering the probable length of time to be allotted for the completion of each group of rooms it was at once apparent that the time necessary to complete one shift set the pace rather than the number of rooms, inasmuch as work might be carried on simultaneously throughout any given area.

Analysis of the work to be performed indicated plumbing, steam-fitting and pipe-covering. Owing to the constricted areas of the shafts and the danger from falling materials it was feasible to undertake but one task at a time. Thus the plumber would first install his risers connecting the two transfer spaces. He then would make his connection to the various toilet fixtures, and while so engaged the shaft was free for the steam fitter to install his new steam return lines. Upon completion of this work the shaft was turned over to the pipe coverers. The shafts servicing exterior-wall radiation were less complicated owing to the absence of hot-water lines. Fig. 3 shows the general progress schedule.

Before any of the vertical work could be undertaken it was necessary first to run the horizontal lines in the two transfer spaces so that individual risers might be cut in without disturbing other

Fig. 3—Time schedule for major operations in main pipe shafts.



portions of the system. These operations were considerably simplified, as the work was for the most part executed during the summer months when steam heating was not necessary.

It was necessary to allow the management sufficient time between group operations to enable them first to remove all furnishings from the rooms to be turned over to the builder and second, upon completion of the various operations included under the general contract, to install the new drapes and furnishings.

The replacement of the elevators required considerable time as it was necessary to work on one car at a time. The freight and service elevators and the food hoist were likewise handled one at a time. In the case of the passenger elevator the original rails were all that was left in the new installation. New cars, elevator doors, signal system and machines were included under the elevator contract.

Little was done to the exterior of the structure except a general cleaning down of brick and terra cotta, repainting and pointing up of the windows and the installation of a new electric sign.

Cost and supervision

The total expense incurred for the entire operation was about $700,000. Of this sum approximately $126,000 was represented by labor alone, the equivalent of 14,000 working days. This cost added to the purchase price of the structure totaled an investment which on a cost per room basis compared very favorably with other hotels of its class.

The contracts were carried on under the direction of D. Everett Waid, architect, New York City, and Walker and Weeks, of Cleveland, as associates, and of the Cleveland office of Clark, MacMullen & Riley, mechanical engineers. The general contract was awarded to the Lundoff-Bicknell Co., of Cleveland. The kitchen equipment was furnished and installed by the Cleveland Range Co. All decoration was under the direction of the Rorimer-Brooks Studio, also of Cleveland.

* * * *

Constructing a New Front on a St. Louis Building

Street widening requires removal of a 40-ft. section of the McNichols Building, a concrete structure with masonry walls—Long concrete girders added in new front wall

By Charles W. Martin
Martin Engineering Co., St. Louis, Mo.

BUILDING ALTERATIONS are often made necessary by events outside the building owner's control. A new subway may pass under or near the building, or the street in front of the building may be widened. Some owners have taken advantage of the required alterations by making them a part of a modernization plan. The operation described in this article is a case in point. A street-widening operation sliced 40 ft. from the building. Instead of moving the old front back to a new location, a modern front was installed in which, unlike the original front, no columns obstructed the show-window space. The structural problem was difficult and required ingenuity and careful construction. —EDITOR.

THE WIDENING of Market St. between Seventh and Twelfth Sts., in St. Louis, necessitated the removal of the north 40 ft. of the old McNichols Building and the construction of a new front. Built in 1904, the building is a six-story mercantile structure 60 ft. wide by 135 ft. long (95 ft. as altered), with reinforced-concrete floor and roof systems that are supported on the interior by three longitudinal lines of beams and columns and at the walls by the walls themselves. It is representative of a type of design somewhat frequently employed in St. Louis before the general adoption of the full skeleton type of reinforced-concrete construction. The longitudinal spacing of interior columns is approximately 16½ ft., and the new front-wall construction is 11½ ft. north of what was, before the alteration, the third transverse line of interior columns.

The structural design for the new front construction is unusual in that a reinforced-concrete frame consisting of a pair of columns at the side walls of the first floor and a pair of 60-ft. girders, one at the second floor and one in the basement, are employed to provide unobstructed store-front construction. The structural framing for the portion of the new front above the second-floor girder is also of reinforced-concrete construction. Here the three columns used are placed in alignment with the three lines of interior columns, and the spandrel beams bear directly upon the brickwork at the corners of the building. Throughout, the bars encountered in the wrecking were employed to anchor the new concrete construction to the old, and brackets were provided to transfer the end loading of the shortened interior beams to the new framing.

The figured concentrated loadings imposed upon the 60-ft. girder over the store front by the upper system of columns and the second-floor beams, which frame directly into the girde are, taken together, 177,000 lb. at th center and 170,000 lb. at the quarte points. These concentrated loads, t gether with a uniform load of 3,900 l per linear foot, give a maximum desi moment of 6,650,000 ft.-lb. (the restrai of the supporting columns being n glected) and a critical shear of 371,0

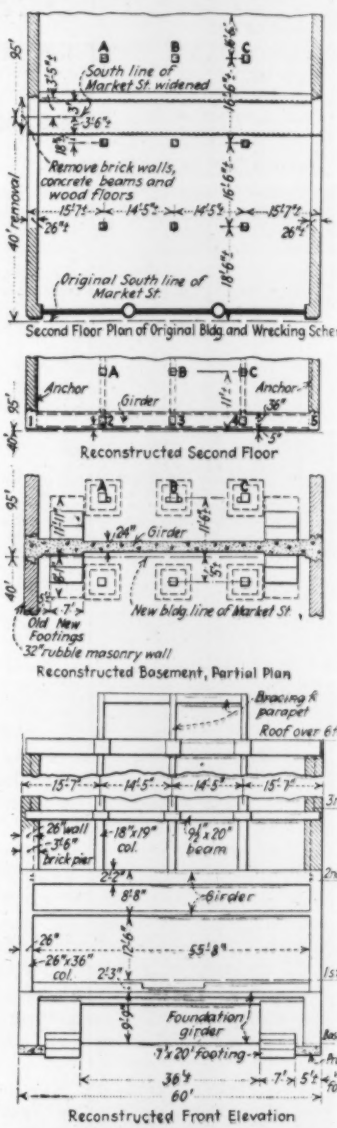


Fig. 1—A 40-ft. section of the McNichols Building in St. Louis had to be removed to accommodate a wider street. The plans and elevation show the scope of the alteration work required and the new concrete girders used in the new front wall.

lb. As designed, the girder is of modified T-section, with the top of the compression flange 2½ ft. above the second-floor slab. The over-all depth of the girder is 8 ft. 8 in., and the stem and flange widths are 27 and 36 in., respectively. The principal reinforcement consists of 21 1¼-in. square bars in compression and 32 1¼-in. square bars in tension. Reinforcement against shear is provided by the bent-up ends of fourteen of the principal tension bars, by sup-

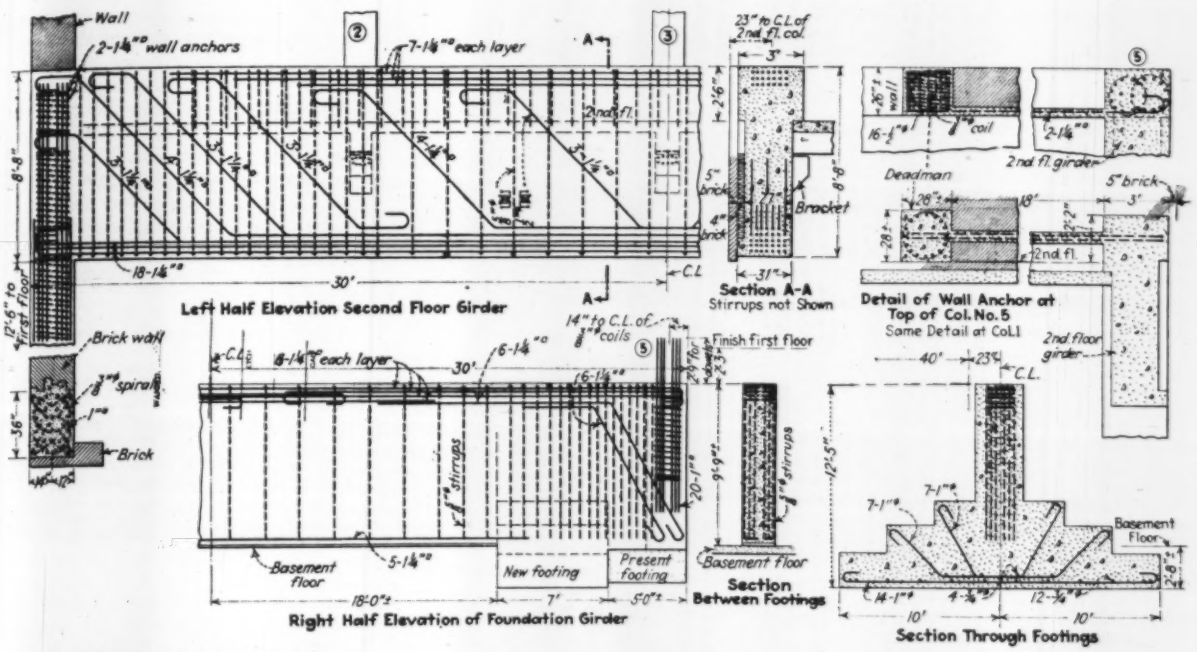


Fig. 2—Details of wide-span concrete frame used in new building front to provide unobstructed show-window space. Note how columns are continuous through second-floor girders; also the anchor detail that ties the new framework into the existing brick masonry walls.

plementary diagonal bars and by stirrups. The stirrups are ⅜-in. round bars grouped in sets of three (six-prong). Their spacing varies from 8- to 9-in. centers from support to quarter point, and throughout the central portion of the girder they are uniformly spaced at 19-in. centers. Supplementing these main stirrups, there is a system of ½-in. round bar stirrups, also grouped in sets of three, inverted over the compression reinforcement at from 12- to 15-in. centers. This second-floor girder contains about 1,650 cu.ft. of concrete and 21,000 lb. of reinforcement.

The two first-floor columns supporting the girder also carry the weight of the brick wall returns directly above them, and their figured axial loading is 496,000 lb. each. The sectional size of these columns is 26x36 in., and each is reinforced with a pair of 20-in.-diameter coils of ⅜-in. round bars at 4-in. pitch nested together, and 24 1-in.-square vertical bars. The column bars are extended up to the top of the second-floor girder, where the columns are anchored to the side walls of the building by two 1¼-in. square bars grouted into a horizontal chase terminated in a concrete slug embedded in the wall 18 ft. south of the south face of the girder.

The foundation girder was designed to form the new north wall of the shortened basement and to transfer the axial loads of the first-floor columns by cantilever action to foundations which were, for construction reasons, located parallel to and on the inner side of the existing side-wall footings. This girder is 9 ft. 9 in. deep, with a thickness of 24 in. between the foundations and 36 in. over and beyond them. The girder's principal (top) reinforcement consists of 24 1¼-in.-square bars that are arranged in four layers and, for construction reasons, provided with splices. Throughout, the girder is reinforced against shear with inverted ⅜-in. round bar stirrups arranged in three sets (six-prong) at spacings varying from 6 in. in the region of maximum shear at each end of the girder to 26 in. in the central portion.

As any extensive settlement was to be guarded against in alteration work of this kind, it was considered imperative that the unit dead load of the soil-bearing foundations for the foundation girder be made relatively light in comparison with the unit dead load of the existing footings. For this reason the new foundations were proportioned on a basis of 3,700 lb. per sq.ft.—approximately 30 per cent less than the 5,400-lb. loading of the existing footings.

In general, the concrete for the structural work was proportioned so that the finished concrete contained six bags of cement per cubic yard, but on account of the somewhat higher than ordinary shearing and compression stresses in the second-floor girder the cement used in that member was increased to seven bags per cubic yard. Throughout, a 3-min. mix was required, and the amount of water used was limited to a maximum of 6½ gal. per bag of cement.

The order of work in effecting the wrecking and construction was essentially as follows: a section of the building 6½ ft. wide was removed between vertical planes 3 ft. south and 3½ ft. north of the street line, as widened. The wrecking for this vertical slot was done from the bottom upward; and as it progressed the beam ends of the shortened interior panel were temporarily shored. The concrete work followed in stages about two stories below the wrecking work. When the structural framing for the new front was completed, the portion of the old structure left standing north of the new street line was removed under separate contract by the city. Following that, the new front construction was completed.

McCormack-Combs Construction Co. were the contractors for the alteration work. Otto J. Kreig, architect, prepared the architectural drawings for the new front elevation. The writer prepared the structural drawings and had general supervision of the work.

Poland Starts Public-Works Program

More than 3,000,000 zlotys, or about $330,000, will be used as the first block of credits in the start of a widespread program to relieve unemployment in Poland. Parliament has been asked to vote additional taxes to add to this fund. The first series of works, begun this month and especially designed for providing employment, contemplates the use of 31 per cent of the 3,000,000-zloty fund for construction of waterworks, 23 per cent for highways, 12 per cent for street repair, and 9 per cent for railway construction. Work is to begin on the Warsaw-Radom railroad line, finding immediate employment for 500 men, with a gradual increase up to 3,000 workers. Employment of 1,000 workers is also provided for in continuation of the work on the new Krakow-Miechow line. New highway construction will be undertaken on the Radom-Kielce-Krakow road and between Krakow and Zakopane. Manual labor will be used as extensively as possible on these projects, it was reported.

The Right Equipment for the Job

Record and analyses of 30 road-grading jobs, aggregating 1,400,000 yd., provide a basis for selecting the economical equipment for the average and the individual grading operation

By H. K. Church
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THIS ANALYSIS of Pennsylvania highway-grading projects has been made for the purpose of supplying certain facts to aid highway building contractors and engineers in selecting the over-all efficient and therefore the economical type of excavating equipment for the average and the individual highway-excavation project.

Specifically, the analysis presents facts concerning what percentage volume and what percentage length of

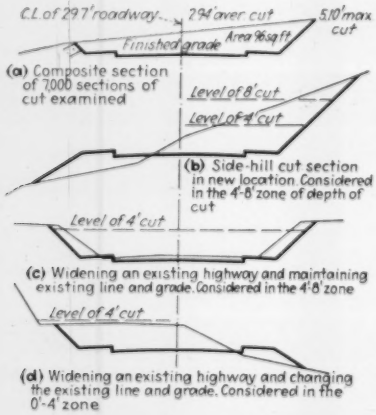

C.L. of 29.7' roadway
29¢ over cut
5.10' max cut
Finished grade
Area 96 sq ft
(a) Composite section of 7000 sections of cut examined
Level of 8' cut
Level of 4' cut
(b) Side-hill cut section in new location considered in the 4'-8' zone of depth of cut
Level of 4' cut
(c) Widening an existing highway and maintaining existing line and grade. Considered in the 4'-8' zone
Level of 4' cut
(d) Widening an existing highway and changing the existing line and grade. Considered in the 0'-4' zone

Fig. 1—Cross-sections of typical highway cuts used in analyses of grading operations.

total excavation may be expected to occur in cuts between 0 and 4-ft. depth, between 4- and 8-ft. depth, between 8- and 12-ft. depth, between 12- and 20-ft. depth, and in cuts of 20-ft. depth and up. These facts are useful both for the average highway-grading job of Pennsylvania and for any particular job in any other locality.

Excavation theory

The writer has ventured into a theory of excavation in the course of the analysis, which he believes will be of interest to both contractors and engineers. The theory indicates that the average excavation job can be rationalized in terms that are applicable to all jobs, with a precision measure but slightly dependent upon variations in the profiles of hills and hollows.

The reason for selecting Pennsylvania for the analysis was that it is probably the most mountainous of the large states east of the Mississippi River, and therefore its average excavation is probably the heaviest.

The analysis was made in November, 1932, and 30 typical highway jobs were examined. They aggregated 120 miles of construction and 1,400,000 cu.yd. of excavation—roadway, borrow and for structures. They ranged from 1,500 to 45,600 cu.yd. of roadway excavation per mile.

The state was divided into quadrants by an east-west line and a north-south line. In order properly to distribute the projects according to volume of work, the north-south line was placed so that it halved the state, and the east-west line was placed slightly below the center of the state, making the north area about 1.4 times the south area. The individual projects were then divided among the quadrants and scattered in each.

The basis of the analysis was the critical examination of each cross-section of the 30 projects analyzed. About 13,000 sections were examined, and 7,000 of these that were in cut formed the basis. Special work-sheets were used for the examination of sections in cut.

For each section four entries were made: (1) the station number; (2) the type, whether through or side-hill cut; (3) the maximum height, or the vertical distance from the highest part of the section to the grade elevation; and (4) the area of the section, according to the average depth of cut, was entered under the proper bracket of depth of cut.

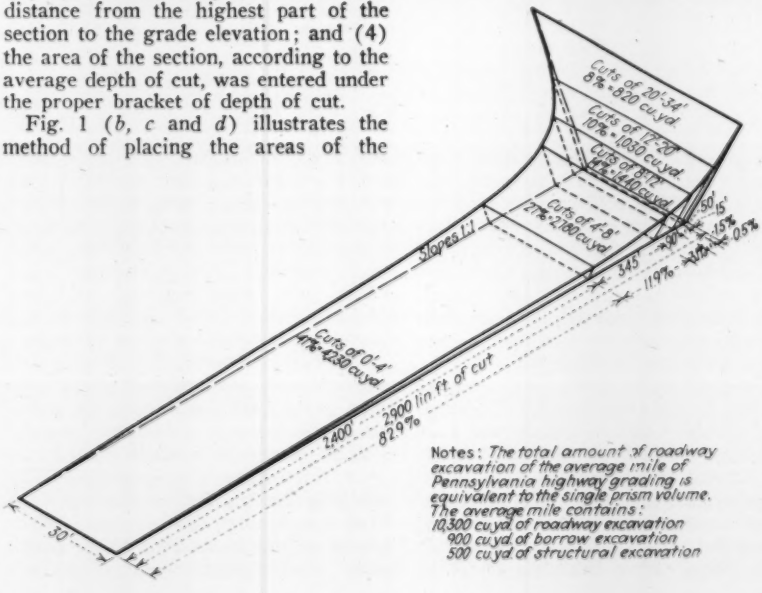
Fig. 1 (*b*, *c* and *d*) illustrates the method of placing the areas of the cross-section in their proper brackets. In a symmetrical through-cut there was obviously no difficulty in bracketing the area properly; in unsymmetrical through-cuts and in side-hill cuts the writer used the method of selecting the average height, as in Fig. 1*b*. Certain data concerning the project in general were also secured from the plans and estimate. All these data for each project were summarized on the master sheet, Table I, to which attention is directed (p. 557).

Volume and length percentages

The method of computing volume percentages was as follows: Only stations or sections at 50-ft. intervals were examined. The average-end-area method of computing volume is equivalent to the method of assuming that each area holds 25 ft. on either side, thereby eliminating averages. The sum of the areas under each bracket, multiplied by 50/27, produced volume in terms of cubic yards. However, in percentage calculations the 50/27 factor became capable of cancellation. Thus is explained the volume calculations of Table I, where percentage volume is identical with percentage area.

The method of computing length percentages was as follows: the number of sections of 50-ft. length in a particular bracket of depth of cut, multiplied by 50, gave the linear length, and a division gave the percentage length.

Finally, in order to present the facts in a simple scale illustration, Fig. 2 was prepared on the basis of the "grand average" figures of Table I. If all the cuts of the average mile of excavation, as shown in Table I, were brought together in the order of depth of cut, the composite prism of Fig. 2 would be the result. In this figure the length, depth and volume are brought together, and the inter-relationship of length,



Notes: *The total amount of roadway excavation of the average mile of Pennsylvania highway grading is equivalent to the single prism volume. The average mile contains:*
10,300 cu.yd. of roadway excavation
900 cu.yd. of borrow excavation
500 cu.yd. of structural excavation

depth and volume of all cuts of the average mile is clearly shown.

Statement of theory

Although the writer sought data concerning the average mile of excavation in Pennsylvania, he thought it advisable to present authentic data concerning the percentage-volume distribution by depth of cut for a job of any figure of cubic yards of roadway excavation per mile between 0 and 20,000.

From Table I it will be noted that there is considerable range in the figures for cubic yards of roadway excavation per mile. At the same time these figures are for roadways of varying widths. After prorating the yardage figures to a roadway width of 30 ft. (the analysis average being 29.7 ft.), the solid empirical curves of Fig. 3 were produced. The method of producing these curves is illustrated by the plotting of the points for the "less than 4 cut" curve of Fig. 3.

(Example: See Table I and Fig. 3. Project I has 8,700 cu.yd. per mile, a 34-ft. roadway and 60 per cent of excavation in cuts less than 4 ft. By prorating, 8,700 cu.yd. became 7,700, and a point was plotted with abscissa of 7,700 and ordinate of 60 per cent.

TABLE I — SUMMARY OF GRADING PROJECTS ANALYZED IN PENNSYLVANIA HIGHWAY WORK

Project No.	Length in Miles	Excavation, Cu.Yd.				Cu.Yd[1] R'dw'y. Exc. Mi.	Cross-Section Data[3]							
		Roadway	Borrow	Structural	Total		Roadway[2]		Number		Maximum Cuts[3]			Average Cuts[4]	
							Width Ft.	Slope	Through	Side	No.	Total Ft.	Aver. Ft.	Total Ft.	Aver. Ft.
1	5.52	48,000		1,900	49,900	8,700	34	1:1	163	132	295	1,134	3.8	770	2.6
2	3.79	19,900	19,400	600	39,900	5,200	28	1:1	110	62	172	605	3.5	371	2.2
3	1.43	64,000		1,500	65,500	45,600	28	1:1	29	44	73	1,382	18.9	698	9.6
4	3.81	49,900		2,700	52,600	13,000	28	1:1	148	82	230	1,244	5.4	740	3.2
5	3.90	67,400	13,800	3,600	84,200	17,200	34	1:1	101	16	117	853	7.3	617	5.3
6	5.32	111,900	2,000	2,800	116,700	21,000	32	1:1	223	117	340	2,060	6.0	1,427	4.2
7	4.94	44,900	2,000	1,200	48,100	9,100	40	1:1	212	100	312	833	2.7	659	2.1
8	8.42	119,000	6,500	5,500	131,000	14,100	28	1:1	155	378	533	4,398	8.2	2,241	4.2
9	6.01	20,800	9,300	2,400	32,500	3,500	28	1:1	166	164	330	629	1.9	463	1.4
10	4.36	43,600	20,900	4,800	69,300	10,000	28	1:1	78	45	123	672	5.4	579	4.7
11	2.99	30,000		300	30,300	10,000	28	1:1	56	156	212	1,520	7.2	756	3.6
12	2.83	28,000		700	28,700	9,900	28	1:1	98	84	182	932	5.1	600	3.3
13	3.31	14,700	3,200	2,300	20,200	4,400	28	1:1	84	58	142	320	2.3	229	1.6
14	3.91	21,200	800	400	22,400	5,400	30	1:1	151	105	256	725	2.8	503	2.0
15	2.76	31,500	1,000	2,100	34,600	11,400	30	1:1	103	61	164	866	5.3	564	3.4
16	12.68	80,400	3,200	3,100	86,700	6,300	28	1:1	336	353	689	2,360	3.4	1,428	2.1
17	7.82	79,000		1,400	80,400	9,900	28	1:1	184	305	489	2,821	5.8	1,278	2.6
18	5.41	47,800	3,100	1,500	52,400	8,900	28	1:1	131	175	306	1,753	5.7	1,034	3.4
19	4.10	43,000	5,300	2,000	50,300	10,500	28	1:1	56	250	306	1,872	6.1	820	2.7
20	3.10	19,600		600	20,200	6,300	28	1:1	78	129	207	866	4.2	506	2.4
21	2.31	23,800	1,900	300	26,000	10,300	28	1:1	36	126	162	1,091	6.7	474	2.9
22	3.17	12,300	5,800	1,400	19,500	3,900	28	1:1	84	65	149	514	3.5	350	2.3
23	2.67	29,100	3,900	1,900	34,900	10,900	36	1:1	82	90	172	856	5.0	478	2.8
24	1.94	30,200		1,100	31,300	15,600	36	1:1	77	26	103	544	5.3	408	4.0
25	1.80	16,400		600	17,000	9,100	28	1:1	54	49	103	537	5.2	310	3.0
26	3.36	5,100		100	5,200	1,500	28	1:1	250	70	320	960	3.0	320	1.0
27	1.50	3,000	1,100	3,000	7,100	2,000	28	1:1	30	29	59	112	1.9	63	1.1
28	2.84	54,400		1,100	55,500	19,200	34	1:1	110	47	157	1,026	6.5	780	5.0
29	1.02	14,700	4,800	4,800	24,300	14,400	26	1:1	24	30	54	508	7.7	242	3.7
30	3.21	61,000	4,400	2,000	63,400	19,000	28	1:1	143	94	237	1,738	7.3	875	3.7
Grand Totals....	120.23	1,234,600	108,400	57,700	1,400,700	.....	892	.....	3,552	3,448	7,000	35,731	.....	20,583	.....
Grand Averages.	4.01	41,150	3,610	1,920	46,680	10,300	29.7	1:1	118	115	233	.....	5.10	.....	2.94

Project No.	Per Cent of Total Excav. in Zones of Depth of Cut											Per Cent of Total Length in Zone of Depth of Cut										Class Material		
	0-4 Ft.		4-8 Ft.		8-12 Ft.		12-20 Ft.		20 Ft. Up		Total Area, Sq.Ft.	0-4 Ft.		4-8 Ft.		8-12 Ft.		12-20 Ft.		20 Ft. Up		Total Length, Ft.	Per Cent Earth	Per Cent Rock[7]	
	Area	Per Cent	Area	Per Cent	Area	Per Cent	Area	Per Cent	Area	Per Cent		Length	Per Cent	Length	Per Cent	Length	Per Cent	Length	Per Cent	Length	Per Cent			Hard	Soft
1	146	60	80	31	16	6	7	3	.....	.....	25,900	127	86	18	12	2	1	1	1	.....	.....	14,800	50	.....	50
2	73	68	15	14	15	14	4	4	.....	.....	10,700	80	92	4	5	2	2	1	1	.....	.....	8,700	70	15	15
3	31	9	14	4	31	9	41	12	229	66	34,600	22	60	4	11	3	7	4	11	4	11	3,700	10	90	.....
4	100	37	70	26	43	16	56	21	.....	.....	26,900	90	78	16	14	6	5	4	3	.....	.....	11,600	50	.....	50
5	58	16	66	18	58	16	69	19	113	31	36,400	38	63	10	17	5	8	4	7	3	5	6,000	90	.....	10
6	194	32	163	27	91	15	121	20	36	6	60,500	118	69	34	20	9	5	8	5	2	1	17,100	33	33	34
7	167	69	58	24	17	7	.....	.....	.....	.....	24,200	142	91	12	8	2	1	.....	.....	.....	.....	15,600	90	.....	10
8	181	28	258	40	142	22	62	10	.....	.....	64,300	170	64	68	26	20	7	8	3	.....	.....	26,600	75	.....	25
9	112	100	.....	.....	.....	.....	.....	.....	.....	.....	11,200	165	100	.....	.....	.....	.....	.....	.....	.....	.....	16,500	100	.....	.....
10	47	20	24	10	24	10	54	23	87	37	23,600	46	74	6	10	3	5	4	6	3	5	6,200	60	.....	40
11	62	38	66	41	21	13	13	8	.....	.....	16,200	76	71	24	23	4	4	2	2	.....	.....	10,600	75	25	.....
12	75	49	49	32	6	4	21	15	.....	.....	15,100	71	79	16	18	1	1	2	2	.....	.....	9,000	30	35	35
13	76	97	3	3	.....	.....	.....	.....	.....	.....	7,900	70	99	1	1	.....	.....	.....	.....	.....	.....	7,100	80	.....	20
14	87	76	22	19	5	5	.....	.....	.....	.....	11,400	120	93	8	6	1	1	.....	.....	.....	.....	12,900	40	30	30
15	70	41	70	41	30	18	.....	.....	.....	.....	17,000	60	90	3	4	4	6	.....	.....	.....	.....	6,700	100	.....	.....
16	231	53	152	35	44	10	8	2	.....	.....	43,500	310	90	29	8	5	1	1	1	.....	.....	34,500	95	5	.....
17	247	58	111	26	38	9	30	7	.....	.....	42,600	216	88	22	9	4	2	2	1	.....	.....	24,400	50	25	25
18	74	29	69	27	15	6	48	19	51	19	25,700	124	82	20	13	2	1	4	3	2	1	15,200	40	30	30
19	132	57	83	36	17	7	.....	.....	.....	.....	23,200	129	84	22	14	2	2	.....	.....	.....	.....	15,300	70	15	15
20	64	60	19	18	23	22	.....	.....	.....	.....	10,600	95	91	6	6	3	3	.....	.....	.....	.....	10,400	70	15	15
21	58	45	57	44	8	6	6	5	.....	.....	12,900	64	79	15	19	1	1	1	1	.....	.....	8,100	75	.....	25
22	40	60	19	29	7	11	.....	.....	.....	.....	6,600	69	93	4	6	1	1	.....	.....	.....	.....	7,400	100	.....	.....
23	87	54	43	27	10	6	21	13	.....	.....	16,100	74	85	10	12	1	1	2	2	.....	.....	8,700	80	10	10
24	41	25	67	41	31	19	24	15	.....	.....	16,300	33	64	14	27	3	5	2	4	.....	.....	5,200	75	.....	25
25	38	43	33	37	18	20	.....	.....	.....	.....	8,900	41	80	8	16	2	4	.....	.....	.....	.....	5,100	60	20	20
26	25	89	3	11	.....	.....	.....	.....	.....	.....	2,800	158	99	2	1	.....	.....	.....	.....	.....	.....	16,000	100	.....	.....
27	12	73	4	27	.....	.....	.....	.....	.....	.....	1,600	28	97	1	3	.....	.....	.....	.....	.....	.....	2,900	100	.....	.....
28	47	16	70	24	123	42	54	18	.....	.....	29,400	46	59	14	18	14	18	4	5	.....	.....	7,800	70	15	15
29	28	36	4	5	11	14	36	45	.....	.....	7,900	27	84	2	6	1	3	2	7	.....	.....	3,200	90	10	.....
30	109	33	102	31	59	18	16	5	43	13	32,900	86	72	23	19	8	7	1	1	.....	.....	12,000	50	30	20
Grand Totals...	2,722	.....	1,794	.....	903	.....	691	.....	559	.....	666,900	2,895	.....	416	.....	110	.....	56	.....	16	.....	349,300	2,078	403	519
Grand Averages.	.....	40.9	.....	26.9	.....	13.5	.....	10.4	.....	8.3	100.0%	.....	82.9	.....	11.9	.....	3.1	.....	1.6	.....	0.5	100.0%	69	13	18

[1] Cubic yards of roadway excavation divided by length in miles.

[2] Roadway = distance between edges of shoulders = pavement + shoulders.

[3] Max. cuts = distance from highest part of cross-section to grade elevation.

[4] Aver. cuts = average distance from ground line to grade elevation.

[5] Only cross-sections at 50-ft. intervals were examined. Hence $\frac{50}{27}$ is a constant which is eliminated in percentage-volume calculations. Volume is therefore proportional to areas of cross-sections in the zones of depth of cut. Two ciphers have been dropped in the areas by zones.

[6] Length refers to the linear length of cuts. Two ciphers have been eliminated in the length by zones.

[7] Soft rock is generally shale, and hard rock is generally sandstone.

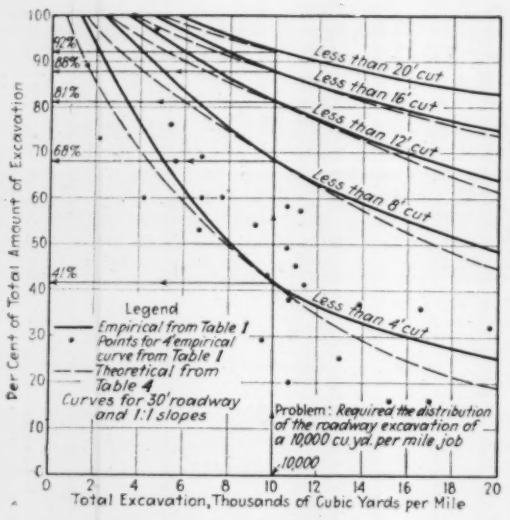

Per Cent of Total Amount of Excavation
Total Excavation, Thousands of Cubic Yards per Mile
Less than 20' cut
Less than 16' cut
Less than 12' cut
Less than 8' cut
Less than 4' cut
92%
88%
81%
68%
41%
Legend
Empirical from Table 1
Points for 4 empirical curve from Table 1
Theoretical from Table 4
Curves for 30' roadway and 1:1 slopes
Problem: Required the distribution of the roadway excavation of a 10,000 cu yd. per mile job
10,000

Fig. 3—Distribution of total excavation according to the depth of cut, shown by empirical and theoretical curves.

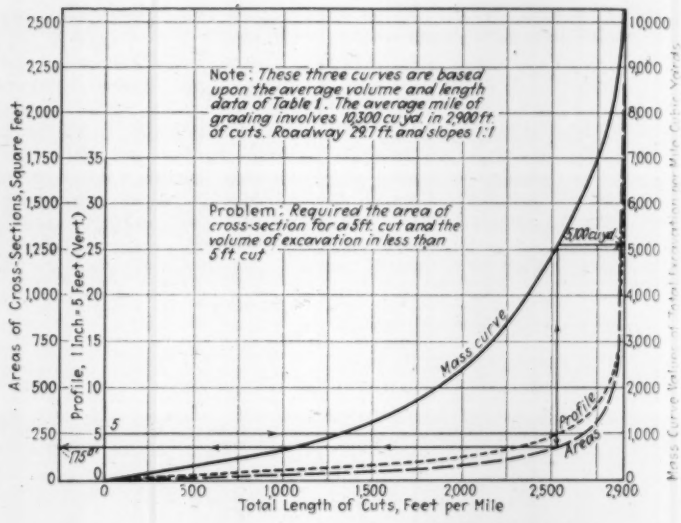

Areas of Cross-Sections, Square Feet
Profile, 1 Inch = 5 Feet (Vert.)
Total Length of Cuts, Feet per Mile
Mass Curve Volume of Total Excavation in Cubic Yards
Note: These three curves are based upon the average volume and length data of Table 1. The average mile of grading involves 10,300 cu yd. in 2,900 ft. of cuts. Roadway 29.7 ft. and slopes 1:1
Problem: Required the area of cross-section for a 5 ft. cut and the volume of excavation in less than 5 ft. cut
5,000 Cu. yd.
Mass curve
Profile
Areas
5
175 sq. ft.

Fig. 4—Profile, areas of cross-sections and mass curve of composite average mile of excavation.

Before producing the curves from the plotted points there was some uncertainty concerning their proper shape because the area covered by the plotted points did not closely determine their shape. In order to arrive at a proper shape for the curves and in order to ascertain what relationship existed between theory and empiricism, Fig. 4 and the theory of Fig. 5 were developed.

In attempting to place the empirical curves of Fig. 3 through the centers of gravity of the areas mentioned, there was naturally some error. Table II shows a 14 per cent deviation between the average project value and the curve value for per cent of excavation in cuts less than 4 ft. of depth. The reader will recognize that the writer considered shape of curve with respect to theoretical curve and position of curve with respect to empirical points. It was impossible to satisfy all conditions without a very great number of observations.

From Figure 2 the characteristic curves of the composite prism were developed in Fig. 4. The reader will perceive a close check between area curve and mass curve, but he will not find a positive check. The reason is that profile, area and mass curves were developed independently from through-cut and side-hill cut data. These curves are based on an average mile of 10,300 cu.yd. of roadway excavation, a 29.7-ft. roadway and slopes of 1:1.

It was desired to develop a similar set of curves for an average mile of 0 to 20,000 cu.yd., a 30-ft. roadway and a 1:1 slope. The following theory was evolved:

Any average mile of grading has the characteristic shape and curves of the "composite mile" (Figs. 2 and 4). The cross-section areas at corresponding points of any average mile and the "composite mile" are proportional to the cubic yards of roadway excavation per mile of any average mile and the composite mile. Consideration of this theory suggested the following:

1. For all average miles the area curves are the same, if the area of each section is considered as a percentage of the maximum area.

2. For all average miles the mass curves are the same, if the volume at each point is considered to be a percentage of the total volume.

3. There is a straight-line relationship between the maximum area of cross-section of any average mile and the cubic yards of the same average mile.

4. Therefore a general set of curves for any average mile, similar to those of Fig. 4 for the composite mile, can be developed.

With this theory and the resultant four points, Fig. 5 was developed, the assumption being made that the cross-sections were all symmetrical through-cuts. The writer wishes to emphasize that the theory was based upon the actual figures of Table I. These figures are for projects involving both through and side-hill cuts. The assumption that symmetrical through-cuts existed was made merely to facilitate calculations and give uniformity to results. In other words, the assumption is a device to secure practical results and not an assumption limiting results.

Attention is directed to the problem of Fig. 5. In step 1 is shown the method of finding the area of the maximum cross-section (second statement of the theory). In step 2 is shown the method of finding the area of the cross-section corresponding to a 12-ft. cut. In step 3, having the percentage relationship between the two areas, is shown the method of finding the percentage volume of excavation beneath the 12-ft. level (first statement of theory and points 1 and 2).

Fig. 5 was the basis of the theoretical dotted curves of Fig. 3. Points along the dotted curves were simply secured from a tabulation of percentages by depth of cut for various figures of cubic yards of roadway excavation per mile of highway.

The theory was developed from a certain point of the empirical results—the composite mile of 10,300 cu.yd. Thus there results the point of tangency of the sets of curves at abscissa 10,300 cu.yd. On either side of this point, however, it is clearly demonstrated that fact and theory can be reconciled. The writer knows that the empirical curves, based on plotted points from Table I, are substantially correct. He believes that the theory developed gives a satisfactory explanation of their shape and characteristics.

In order to check the results of the analysis, the percentage deviation of the grand average figures of Table I is calculated below:

From average figures of Table I:	
Total length of all cuts, ft.	349,300
Average width of roadway, ft.	29.7
Average height of all cuts, ft.	2.94
Average slope of all cuts	1.1
Resultant total volume of excavation by formula, cu.yd.	1,242,000
Total volume of excavation from Table I., cu.yd.	1,234,600
Per cent of deviation	0.6

TABLE II—DISTRIBUTION OF TOTAL EXCAVATION FOR 5,000 CU. YD. PER MILE JOB

	Less Than 4-ft. Cut, Per Cent	8-ft. Cut, Per Cent	12-ft. Cut, Per Cent	20-ft. Cut, Per Cent
Project No. 2	68	82	96	100
Project No. 13	97	100	..	..
Project No. 14	76	95	100	..
Average of above projects	80	92	98	100
From curves of Plate V	69	88	95	100

Results of study

Table I gives the volume and length distribution by percentages, according to depth of cut, for 30 individual projects and for the average project or average mile of excavation.

Fig. 2 gives a picture of the average or composite mile of excavation, in

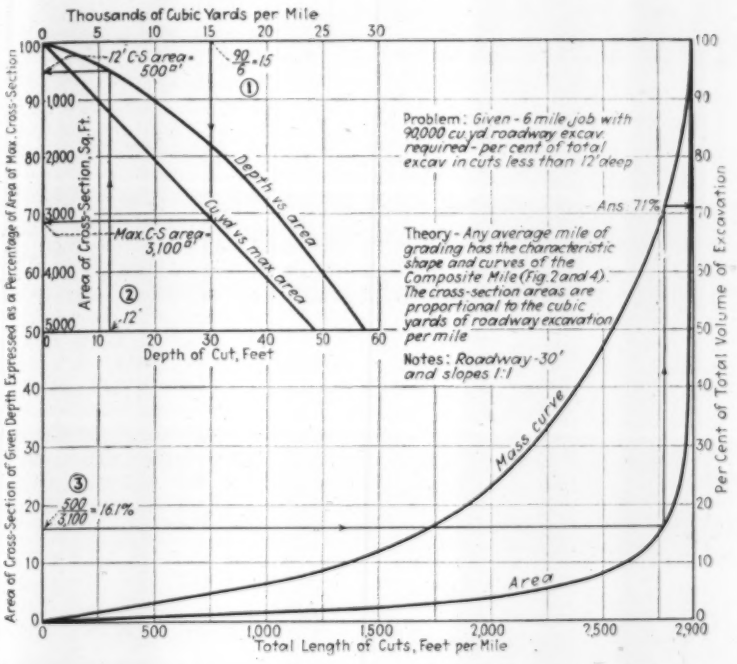

Thousands of Cubic Yards per Mile
Area of Cross-Section of Given Depth Expressed as a Percentage of Area of Max. Cross-Section
Area of Cross-Section, Sq. Ft.
Depth of Cut, Feet
Total Length of Cuts, Feet per Mile
Per Cent of Total Volume of Excavation
12' C-S area = 500 sq ft
90/6 = 15
Depth vs. area
Cu.yd vs. max. area
Max. C-S area = 3,100 sq ft
12'
500/3,100 = 16.1%
Problem: Given - 6 mile job with 90,000 cu.yd roadway excav. required - per cent of total excav. in cuts less than 12' deep
Ans. 71%
Theory - Any average mile of grading has the characteristic shape and curves of the Composite Mile (Fig. 2 and 4). The cross-section areas are proportional to the cubic yards of roadway excavation per mile
Notes: Roadway - 30' and slopes 1:1
Mass curve
Area

Fig. 5—Theoretical analysis of any average mile of grading. Distribution of excavation is according to depth of cut.

terms of length, depth and volume of cuts.

Fig. 3 gives a graphic solution for the percentage distribution of total excavation for any average mile of excavation between the limits of 0 and 20,000 cu.yd. of 30-ft. roadway excavation per mile.

Table I also gives general data concerning amounts of excavation and depths of cut in borrowpits and in structural excavation.

Since Pennsylvania was chosen as a typically mountainous state, we should expect the grand average figures of Table I to be specifically applicable to West Virginia and other mountainous states east of the Mississippi River, and generally inapplicable to Illinois and other relatively flat valley states. On the other hand, the writer believes that the empirical curves of Fig. 3 are generally applicable to any state east of the Mississippi, since the data upon which they are based were derived from projects located in all kinds of Pennsylvania nia topography—flat, rolling, hilly and mountainous. Exception is taken in the case of states west of the Mississippi, because the Rocky Mountain and coast states are characterized by generally heavy excavation. They are therefore considered without the scope of the analysis, except where projects in these states average between 0 and 20,000 cu.yd. to the mile for 30-ft. roadway. Whereas a 25,000-yd. job is considered heavy east of the Mississippi, the writer knows of several Western jobs that ran at 75,000 cu.yd. to the mile and occasioned no comment.

For the contractor and engineer

The general contractor, who today bids a pavement-widening job of 2,000 cu.yd. to the mile and tomorrow bids a location job of 20,000 cu.yd. per mile, will be particularly interested in the grand average figures of Table I, and he will be generally interested in the individual project tabulations and in the resultant general curves of Fig. 3.

For him Tables III and IV are presented, giving the average figures of the analysis, the corresponding figures for 1931 and the corresponding figures for the year 1932. The 1931 figures are by the courtesy of the Pennsylvania highway department, and the present figures are based on the assumption that they will be about 90 per cent of the 1931 figures, the tendency being to lighten up on excavation at the present time.

The contractor who specializes in paving work with attendant light excavation or who confines his work to a given locality where the amount of excavation runs light will be particularly interested in the light excavation projects of Fig. 2 and in the curves of Fig. 3 as applied to jobs that run at about 5,000 cu.yd.

TABLE III—AMOUNTS OF EXCAVATION (CU. YD.) PER MILE OF HIGHWAY GRADING

Type of Excavation	Analysis	1931	1932
Roadway	10,300	8,107	7,300
Borrow	900	976	880
Structural	500	379	350
Total	11,700	9,462	8,530

TABLE IV — PERCENTAGE DISTRIBUTION OF TOTAL VOLUME OF EXCAVATION BY DEPTH OF CUT

Classification by Depth of Cut	Analysis, Per Cent	1931 Per Cent	1932 Per Cent
In cuts less than 4 ft. deep	41	50	54
In cuts less than 8 ft. deep	68	75	78
In cuts less than 12 ft. deep	82	86	88
In cuts less than 20 ft. deep	92	95	97

Above values from Fig. 3.

to the mile, or perhaps lighter. He will find that he may expect his cuts of 4 ft. and under to run higher than 69 per cent of the total excavation, his cuts below 8 ft. to run higher than 88 per cent, those below 12 ft. higher than 95 per cent, and he may expect no cuts greater than 20 ft.

For those contractors who prefer individual actual to average actual records the writer suggests the use of the individual project tabulations of Table I.

For instance, assuming the contractor selects 5,000 cu.yd. per mile as being the average job which he bids, he has only to select a few similar projects of Table I in order to get approximately the same information as he might have secured from the curves of Fig. 3.

Taking the example of the preceding paragraph (5,000 cu.yd. per mile) and selecting projects 2, 13 and 14 of Table I, we find the comparison between the results of the curves of Fig. 3 and the actual figures for three approximately equivalent projects, in Table II. In this case the curves of Fig. 3 appear to give too conservative values.

The contractor and engineer can therefore arrive at the desired information from either of two angles. With regard to the percentage distribution of length of cuts according to depth of cuts, Figs. 2 and 4 illustrate the very high percentages of linear length of cuts which exist in cuts less than 4 ft., less than 8 ft. and in less than 12 ft. These percentage figures are slightly raised and slightly lowered according as the figure of cubic yards per mile decreases below or increases above 10,300. It is not thought necessary to enlarge upon this subject at length.

Conclusions

The writer hopes that both contractors and engineers will find the analysis helpful in the appraisal of the excavation of the average job. He hopes also that the analysis will be of value in the selection of the economical excavating utility for the average excavating project and for specialized highway construction.

In the past, very little, if any, consideration has been given to this subject, the standard shovel having been chosen indiscriminately for highway-grading projects and the plunger shovel or skimmer for street-paving jobs, without regard to depths of cuts. Indications are that unit cost of excavation will be considerably lowered by using the plunger shovel throughout on jobs where the greater proportion of the yardage is to be taken from cuts under 12 ft. deep, a condition that frequently prevails where the yardage per mile is less than 15,000 cu.ft. for a 30-ft. roadway.

Acknowledgment

The writer makes thankful acknowledgment to P. M. Tebbs, assistant chief engineer of the Pennsylvania highway department, whose interest and cooperation made the analysis possible.

Reinforced Concrete in the Long Beach Earthquake

Damage, although slight, revealed some weaknesses that can be remedied—Beneficial bracing effect of concrete walls is notable

By Norman B. Green
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THE LONG BEACH earthquake of March 10, 1933, affords engineers an excellent opportunity to study the effects of a destructive shock upon all the different types of modern American construction. The following observations relate largely to reinforced-concrete construction. [The author also discusses brick and steel-frame construction, but this part of the report is omitted because it largely repeats what has been published previously in our issues of March 16, 1933, p. 353; March 23, p. 378; and April 13, pp. 474 and 476.—EDITOR.]

There are a considerable number of reinforced-concrete buildings in Long Beach, of varying height, shape of floor plan and type of floor framing. An analysis of the damage that they sustained indicates a general similarity of action, from which certain conclusions can be drawn. It was very noticeable that whereas the columns in many instances had suffered severe injury, the floor framing was usually intact, with the exception of occasional cracks in spandrel beams, particularly where they meet the corner columns. This is true of the California Garage, a three-story concrete beam-and-joist structure 150 ft. square, with 13-in. brick curtain walls, in which nearly all the columns in each story showed evidence of a varying degree of flexural failure. The Artaban Apartments, 40x150 ft. in plan and eight stories high, with beam-and-joist framing and 8-in. tile curtain walls, exhibited cracks at the junction of the first-story wall columns with the second-floor wall beams, even though the beams were seldom cracked. The Ambassador Apartments, of four and five stories, with beam-and-joist framing and 13-in brick curtain walls, also illustrated the same effect, with horizontal tension cracks visible in many of the interior columns that were exposed, as well as in some of the first-story wall columns at the soffit of the second-floor beams. In this building there is also an elevator pent house, all four columns of which failed top and bottom in tension, with the beams uninjured.

It seems probable that in a reinforced-concrete structure the column bending moment is distributed laterally to a considerable width of floor system. Thus, unless the column is specifically designed to resist lateral bending, it will fail, while the floor may show no sign of distress. On this supposition, wall beams would be more apt to crack than would interior beams, since the former can be relieved of stress by distribution of the moment in only one direction, while with interior beams it can travel laterally both ways from the column. In only one or two instances was there evidence that the failure of the column could be attributed to a plane of weakness at a construction joint, while the cracks in nearly every case were irregular, and spalling revealed what was apparently sound concrete.

Fig. 1—Huntington Beach High School, whose brick walls and wood floors and roof were given support by a fireproof corridor with concrete floors supported on concrete columns.

Bracing effect of walls

The great value of reinforced-concrete walls as bracing against lateral forces was everywhere very evident. A valuable comparison illustrating this fact may be made between the California Garage already described and the Loynes Garage, which is three stories and basement of beam-and-joist construction, but with 6-in. concrete curtain walls instead of brick walls. The former building had wide diagonal cracks in the east and west walls and suffered extensive structural injury as already described. On the other hand, the injury in the Loynes Garage was confined to the exterior walls, where there was considerable broken wire glass, with an occasional bent or broken steel sash bar and narrow diagonal or vertical cracks extending from the corners of many of the windows. A similar comparison can be made between the Artaban Apartments, already described, and the eight-story Professional Building, which is 50x150 ft in plan, of concrete beam-and-joist construction, but with 6-in. reinforced-concrete curtain walls. In this structure the north and south walls, which are cross-wise of the building, were extensively cracked from the corners of the windows, but these walls took most of the lateral load so that the structural columns were apparently entirely uninjured, while injury to the partitions was mainly confined to the first story, where there were x-cracks in a north and south direction. In the case of the Artaban Apartments, however, the 8-in. tile walls were badly cracked and broken out in the lower stories, and evidently added little or no stiffening to the building so that the frame itself was injured.

An examination of the cracks in the rear wall of the Professional Building demonstrated that it acted as a portal frame, with horizontal and vertical members formed by the piers and spandrels. In this case the damage was the reverse of that sustained by the usual concrete frame, since the spandrels were cracked but not the piers, indicating probably that the spandrels, by reason of their relatively great stiffness, received little support from the floor framing. The damage was confined to the outer bay on each side, and every spandrel up to the eighth floor was cracked clear across where it meets the corner pier. This indicated that the outer piers probably resisted the same lateral shear as the interior piers, in which case the resulting moment was resisted by one spandrel intersection instead of two, with a crack as the result. A uniform lateral-shear distribution between end and interior piers of equal width is what would be expected in a frame having short and wide members, in which shear deformation is predominent. Evidently outer spandrels should be given special reinforcement and particularly where they meet the corner pier. When, as in this wall, the windows are placed in pairs with a

relatively narrow pier between, the spandrel should be considered as a single member under this window unit, since horizontal shear cracks due to flexure, where they occur, are always continuous for this length of spandrel.

It was very noticeable in all concrete walls that there was a plane of weakness at the floor line and sometimes also at the ceiling line, due of course to the existence of a construction joint at this location. In almost all multi-story buildings with reinforced-concrete walls, these were cracked horizontally for the length of the spandrels in many places, and often these cracks constituted the only damage to the wall. It is certain that some better bond should be provided at construction joints than is the usual practice, and particularly is this true where the wall is intended to act as lateral bracing. Since the deformation is evidently that of shear along the plane of the joint, requisite keys should be provided to transmit this stress.

Concrete-joist floors

It has been argued against the concrete-joist type of floor construction that it is inadequate to distribute heavy lateral forces properly, and there was some evidence that this objection may be well founded. The Campbell Apartments, a ten-story steel-frame structure, 55x160 ft. in plain and oriented with its long dimension north and south, afforded a good test of this contention. The building has concrete joists running east and west and 6-in. reinforced-concrete curtain walls, which, being much stiffer than the interior bents, should have forced a horizontal load distribution. A careful examination of the under side of the second-floor slab revealed narrow diagonal cracks entirely across some of the bays adjacent to the rear wall and transverse cracks perpendicular to the joists and extending entirely through many interior panels. These are such cracks as would be produced by the floor system acting laterally as a horizontal beam. It is possible that with the joists running in the opposite direction the floor would be stronger.

Bending failures in columns

The fifth story of the Ambassador Apartments and the third story of the California Garage illustrated the fact that great care should be exercised in designing concrete columns that support a long-span roof system, when these columns form part of a continuous structure and are not free to swing with the earth shock. In such cases adequate bending resistance should be provided, particularly in the direction in which concrete tie beams are not practicable. In the garage building the third-story columns are tied together in an east-and-west direction by reinforced-concrete tie beams, but in the opposite direction the framing consists of heavy timber trusses on a 50-ft. span. Every column in the story, with the exception of those in the east wall, failed at the base due to a rocking motion in a north-and-south direction. Most of the columns spalled out at the floor on the north and south faces so as to expose the reinforcing steel, which in some cases buckled outward. The fifth story of the Ambassador Apartments is an open loft, 50x75 ft., with wood trusses of 50-ft. span extending east and west and resting on concrete wall columns. Every column that was visible failed in tension due to flexure in a north-and-south direction.

It is believed that the quality of the concrete employed in Long Beach was in general quite good. An exception is the four-story Board of Education Building, a beam-and-joist structure in which both the front and rear concrete walls were badly shattered, damage directly attributed to very weak concrete.

Concrete corridors in schools

So much damage was done to public schools in the earthquake region that it seemed almost as though these had been singled out by fate as an object lesson. The destruction of these buildings, erected with brick bearing walls and wood floor and roof framing, has been described in previous reports in these pages. One type of design, however, has not been commented upon. This is illustrated by schools that employ a corridor with reinforced-concrete floors supported on concrete columns, in combination with external brick bearing walls and wood floor and roof construction for the class rooms. While this construction was originally intended simply to provide a fireproof exit through the corridors, it proved to be earthquake-resistant as well, since the stiff corridor framing provided excellent support for the exterior walls when these were properly anchored to it. The Huntington Beach Union High School, shown in Fig. 1, is of this type, and it was uninjured except for an occasional slight crack. The Lowell Elementary School in Long Beach (Fig. 2) on the other hand, although having such a fireproof corridor was badly damaged because it was constructed with two 13-in. brick bearing walls along the line of the corridor and a concrete slab spanning between them. These walls offered little or no bracing, so that the building suffered accordingly.

Fig. 2—Lowell Elementary School, Long Beach, had a concrete-floor corridor, but it spanned between brick walls instead of concrete columns, and so did not offer the bracing effect believed to have saved the Huntington school from damage.

Other examples of schools with concrete corridors which stood almost intact are the Lindbergh and the U. S. Grant schools, both in Long Beach.

Earthquake action

When an effort is made to determine the nature of the earth motion in this earthquake, by the observation of its effect upon structures, the usual anomolies appear. It seems reasonably certain, however, that in Long Beach that part of the motion having a magnitude and frequency of acceleration (which gave a destructive combination for most buildings) was in general in a north-and-south direction. The cracks and spalling in the columns of the California Garage all showed clearly a destructive flexure in this direction, as did also the cracks in the columns of the Ambassador Apartments. In the Professional Building the north-and-south first-story partitions were heavily x-cracked, but those running east and west were undamaged. The front wall of the Long Beach Polytechnic High School and the rear wall of the Board of Education Building each face west and were obviously parallel to the direction of the destructive shock. In the case of the last-named building the side walls were practically uninjured.

Such evidences of a major north-and-south motion can be multiplied indefinitely. However, there is also some evidence of destructive damage due to an east-west acceleration. For example, an 8-in. brick wall 8 ft. high that extended along the north, east and south sides of an athletic field at the

Woodrow Wilson School was broken off at the ground level and thrown down. This wall was laid with good lime-and-cement mortar; and if a modulus of rupture of from 100 to 200 lb. per sq.in. is assumed, the requisite acceleration ranges from 0.4 to 0.8 gravity. This instance is believed to be typical and indicates that there was probably a secondary motion in both directions of high acceleration and high frequency, which affected only relatively stiff structures such as this wall. As another instance of this same effect may be cited the case of the north wall of a four-story reinforced-concrete flat-slab building at 4th and Pine Sts., Long Beach. This entire length of wall for 160 ft., including the heavy wall columns, was sheared through along a horizontal line at the window heads. On the other hand, the two street fronts, having narrow piers and a much greater flexibility, were uninjured except for broken plate glass. It is probable that there was a laitance joint along the line of the window heads, which had the effect of rendering this wall weak, while not affecting its stiffness.

In conclusion, it seems that any effort at an interpretation of the structural damage in terms of acceleration alone brings the usual contradictions, due to the equal importance of period of acceleration and stiffness of the structure.

Andean Mud Slide Destroys Lives and Property

Slide at Charat, Peru, although unusually destructive, is typical of periodic slides or "huaicos" that are caused when heavy rains wash the powdery overburden from the hills into deep gulches, forming moving rivers of mud

By C. W. Sutton
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Early on the morning of March 26, following several days of torrential rains, a huge landslide in the upper regions of the Andes Mountains in Peru practically destroyed the village of Charat, taking about 120 lives. Press reports to this country lacked details, and since the slide appeared to be of major size, a special cable was sent to Lima. M. L. Bohan, American commercial attaché, appealed to Mr. Sutton, who responded with an excellent account, which not only explains the Charat disaster but presents a striking picture of the Peruvian "huaico," or mud slide. Inasmuch as similar phenomena occasionally occur in this country, the account is not only interesting but instructive. —Editor.

THE DISASTER that befell the farmers of Charat, a village about 5 miles from the town of Usquil, was serious and unusual, but phenomena of the kind that caused it are by no means uncommon in Peru. While the writer cannot describe the features of this particular "slide," he has seen similar ones in the same region, where he made topographic and hydrographic surveys in 1909 and 1910, and has observed such "slides" or "huaicos" throughout the Andes. The term "huaico" has been not improperly translated "landslide," yet it is a particular kind of slide. In Appleton's dictionary "huaico" is described as a large mass of rock fallen into a river or stream and is noted as a term peculiar to Peru. This definition is not exact, for a huaico is a flow of a considerable mass of mud. It may bear, and of course usually does bear, rocks, rock fragments and sometimes immense boulders weighing as much as 100 tons or more. It may be caused by a sudden rain in hills bordering a dry gulch, which catches and carries off the thin powdery overburden. Or, the mass or masses of overburden may slide into a flowing stream in such quantities as to absorb the water of the stream and create a flowing plastic mass.

The huaico may move down a valley within the confines of the natural stream channels without exceeding previous flood levels; in this event the damage it does is confined to the choking of irrigation intakes and drainage outlets, the turning over of bridge piers and the like. Damage is more serious, however, when it moves above the ordinary flood level as it often does in small valleys of restricted waterway. Huaicos are frequently ejected from the steep alluvial fan of some relatively small dry watershed at the base of the Andes; these fans form the cultivated or inhabited sections of the Pacific coastal plain, so that in this case damage is often severe. Very often also a huaico occurs in some canyon or gulch tributary to a flowing stream or river which may have a discharge at the time of as much as 3,000 or 4,000 sec.-ft. In such cases the huaico has dammed the river with a hydraulic-fill dam for several hours, or until the pressure behind the fill and within it or the overtopping of the huaico mass by the flow of the main river causes a break. Then a flood wave rushes downstream, mixed with the mud of the huaico and destroys everything in its path. Although the press notices do not enable one to judge it is probable that something like this last-named type of occurrance happened at the village and farming community of Charat near Usquil.

As one travels among the foothills and into the higher levels of the Andes, he sees constant warnings of these huaicos in the seasonal and climatic variations and in the soils slowly forming on the steep arid and semi-arid slopes. Huaicos are a great source of vexation to the irrigation, the highway and the railroad engineer. They often suggest the need of wide bridge spans with heavy piers. But the tempation to put in lighter and cheaper structures is present because the heavy rains and seepage between the overburden and the rock, which cause the largest huacios, may not be effective except at intervals of several years. Records seem to point to cycles of seven with major cycles of 28 years, although observations do not cover a sufficiently long time to indicate how strong this tendency toward periodic repetition is.

The village of Charat is near the thalweg of one of the subtributaries of the Chicama River and near the lower and downstream end of the zone of steep clay slopes that mark the transition from the rounded topography and glacial cirques of the higher Andes, (above 12,000 or 13,000 ft. elevation) to the more angular and rugged topography of the lower levels. These clay slopes often represent unusually deep deposits of overburden and have resulted from river-worked glacial deposits and moraines remaining as river terraces and banks above the level of the stream as it has cut its way into the rocks below the glacial deposits. They occur on the Pacific side in the region of transition from the summit rainfall of 3 to 4 ft. per year to the semi-arid conditions, with rains less than 8 in. per year, occurring at elevations below 9,000 or 10,000 ft. This is the chief region of heavy landslides and huaicos on the Pacific side of the Andes.

In conclusion, present knowledge of huaicos and their relation to landslides may be condensed in a classification of huaicos according to the topographic and climatic belts where they occur. We then have:

1. The coastal huaico. This occurs upon the barren hills forming the base of the Andes on the Pacific coastal plain and extending inward without reaching the regions of major stream erosion at a higher level. Year after year the rocks disintegrate, forming a light thin powdery soil, often only a few inches deep but sometimes reaching a depth of 2 or 3 ft. Even in dry weather on steep slopes these losely consolidated particles slip off in small masses into the gulches below. The rains are normally not enough to wash them down in huaicos, and they go on forming small alluvial fans at the mouths of the lateral gulches. Then there comes some such climatic variations as oc-

curred in 1925 when the Humboldt current was submerged beneath a mass of warm water from the equator. The coastal climate became several degrees warmer than normal in summer, resulting in much greater evaporation, in warm masses of vapor condensing on the coastal hills and in a rainfall on the coast that jumped from 4 in. per year to 30 in. in 2 months. The dry powder, loosely lying upon and thinly covering the hills adjacent to the coastal region, was washed down at once, forming mud flows in the smaller gulches. Owing to the lighter soil covering, the coastal huaico is not associated with a true landslide as such.

2. The Quebrada huaico. Quebrado is the name given to the long narrow gorge that extends, in the Pacific river systems, from the coastal plain to the junction of the main tributaries from the higher parts of the watersheds. The region is characterized by arid appearance, rains of less than 6 or 8 in. per year, rugged sharp spurs, narrow river terraces, and steep slopes rising from the stream level to 5,000 to 10,000 ft. elevation. Here the causes of the coastal huaico are more strongly produced, and here it is that the mud barrages are sometimes formed across the main rivers by flows of mud from the dry lateral gulches in years of unusual rainfall.

3. The huaico of the Sierra. The word "Sierra" is given to the region where the sharp rugged and dry country of the quebrada is replaced by the bolder, more massive, though not less rugged and steep, topography of the region of perennial rains in excess generally of 8 in. and occupied by the main tributaries of a watershed before they have all united into one main trunk. It is hard to give vertical boundaries to the Sierra region, but going eastward one enters it at about 4,000 to 6,000 ft. above sea level and emerges from it at about 11,000 to 13,000 ft. into the summit region of the Andes, or "puna." This is a region of massive rounded forms, broken by separated spurs and peaks often rising to over 17,000 ft., on the flanks of which minor local slides may occur.

The most serious landslides and huaicos in Peru occur in the upper Sierra region, where the summit slope changes abruptly into the steep slopes forming the deeply eroded upper Andean valleys. It is here that the slides which damaged Charat occurred.

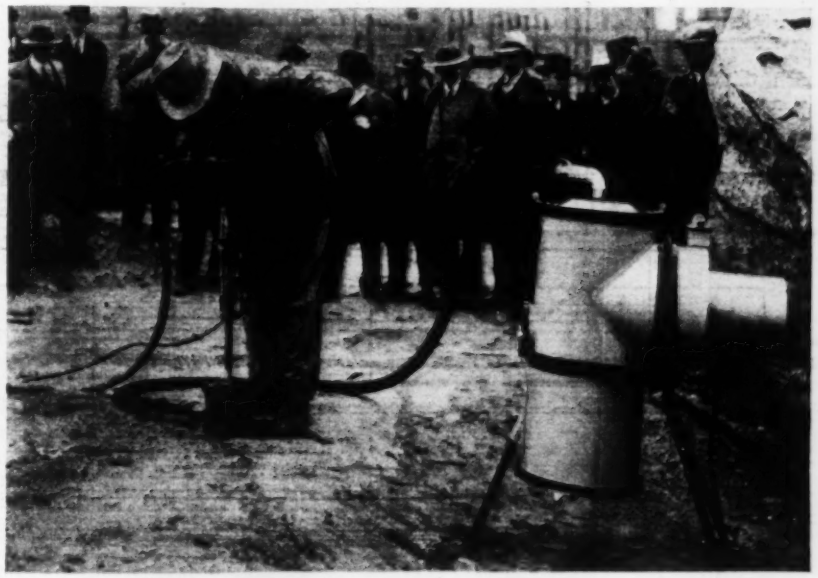
Portable Drill-Dust Collector Demonstrated at New York

A SMALL portable dust collector, designed especially for use with hand rock drills, was demonstrated April 25 at New York on the site of the three 1,100-ft. municipal piers under construction at 48th St. and the Hudson River. The apparatus was developed for the prevention of silicosis in rock-drilling work by James H. Markley, New York foundation contractor, and the Spencer Turbine Co., of Hartford, Conn. Favorable opinions on the application of the machine to the rock-drilling field were expressed by the group of spectators representing contractors, insurance companies, labor and industrial organizations and the U. S. Bureau of Mines.

The apparatus works on the principle of the vacuum cleaner, with an induced vacuum picking up the dust as it leaves the drill hole and trapping it in a separating unit. The separating unit contains the motor, fan and duck-bag separators. The collecting unit consists of a simple hood made up of a 6-in. pipe nipple that sets over the drill hole, open at the bottom and capped with a 1-in. rubber slab or gasket. In the center of the gasket is a hole through which the drill steel operates, the hole being split in four directions to admit the widened drill bit. A short 2-in. nipple is tapped into the side of the hood, to which a 2-in. hose is attached by a simple slip connection.

Compact separator unit

The separator unit is a vertical cylindrical steel tank mounted on three legs and equipped with carrying handles. Air suction for the operation of the apparatus is created by a three-stage exhaust fan direct-connected to a ¾-hp. electric motor, both fan and motor being mounted on the outside of the cylindrical tank. The motor operates at 6,000 r.p.m. Dust collected at the hood is carried through the hose to the top of the separating tank. Within the tank are three duck fabric bags that trap the dust, dropping it into a pan at the bottom of the unit, the air stream passing out through the sides of the bags into the fan. Both motor and fan are mounted on ball bearings. The entire unit weighs 130 lb.



Portable dust collector designed to eliminate the silicosis hazard in rock drilling. Illustration shows the absence of dust around the drill when operating at full speed with the bit inside the hood.

At the demonstration a single jackhammer drill and one hood were used, though the capacity of this size unit is rated at two drills. Hoods adaptable to horizontal and overhead drilling for use with drifters and stopers are under development. The manufacturer claims units can be built up to 40 drills capacity, though the larger units would necessarily be stationary. Air motors or gasoline engines can be substituted for the electric drive if desired.

According to the inventor, drilling speed is increased about 25 per cent by the use of the dust collector, and further tests along this line are now under way. Efficiency tests made in the laboratory of the manufacturer are stated to have shown that the apparatus reduces the dust count of the surrounding air well within the hygienic limits prescribed by the U. S. Bureau of Mines, catching most of the harmful fine dust under two and three microns in size. Further tests of dust-collecting efficiency are being made.

Consequences of Inflation on Construction

Past relations of construction and business indicate that the present gap between commodity prices and construction costs will soon close by virtue of higher commodity prices, and construction activity will increase

By Thomas F. McSweeney
Department of Building Construction, Massachusetts Institute of Technology, Cambridge, Mass.

DURING the past four years, while the volume of construction has been falling nearer and nearer the vanishing point, there has been endless discussion about the relatively stable level of construction costs. Builders who have seen prices in most commodities continue their long and steady drop have felt that construction costs must drop with other prices, before construction could hope for marked reactivation.

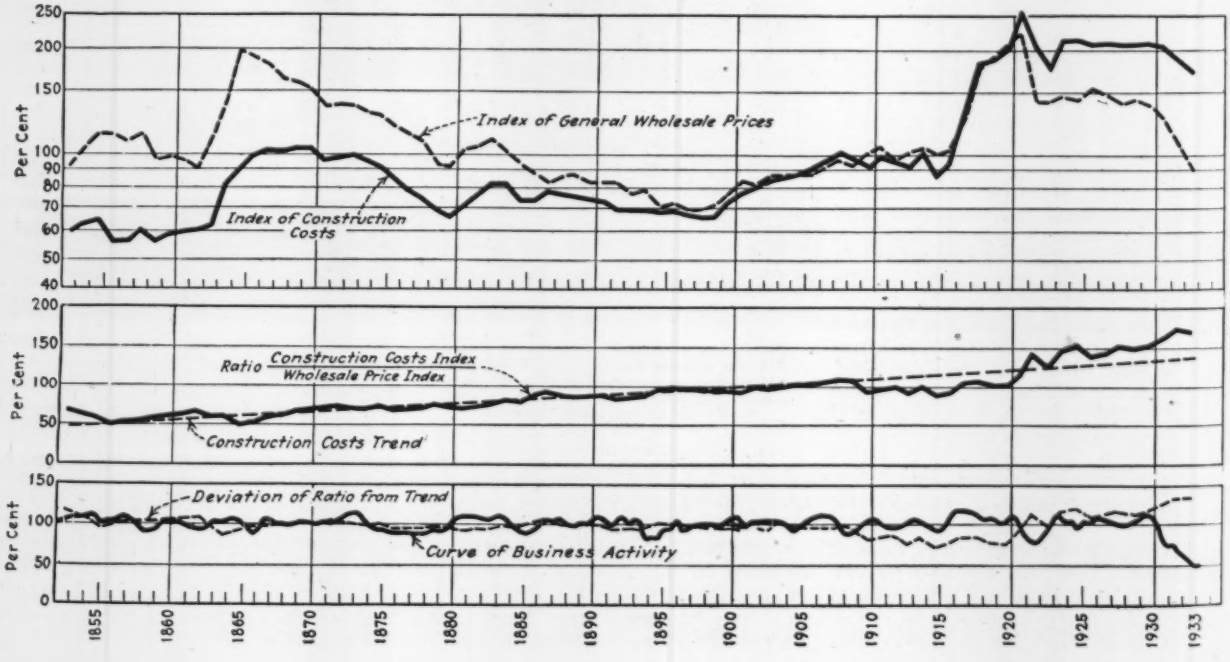
One of the outstanding features of any period of prolonged deflation, such as the one from which we seem to be emerging, is that great inequalities develop between the prices of different classes of goods. Articles made in large plants, or controlled by monopolies, or protected by patent, tend to drop only slightly in price. At the other extreme such things as foodstuffs are subject to large fluctuations. It is obvious that the farmer (to take the most commonly quoted example), whose product brings him in a fifth as much as it once did, cannot buy many farm machines if the manufacturer continues to charge the same prices for the machinery. There is no doubt that such price inequalities cause distress, and that the wide gap between costs of construction and the costs of other things has hurt construction.

There are two ways to close such a gap: one is to force down construction costs, and the other to raise general prices. The first, deflation, is the method that we tried from 1929 to March, 1933. The second is inflation, which at the time this is being written (late in April) seems to be rapidly approaching actuality.

In order to present graphically the situation as it has developed up to date, curves of the variation of construction costs and of the change in general wholesale prices are plotted herewith. The upper set of curves uses the *E.N.R.* construction-cost index from 1903 to date and the commodity-price curve from data computed by Professors Warren and Pearson of Cornell; the plotting is semi-logarithmic.

Probably the chief point of interest shown by these curves is the gradual increase of construction costs as compared to the commodity-price index. This is largely due to the fact that construction has, to date, made less use of machine methods and large-scale production than most other industries, and as a consequence its costs have not been benefited as have the costs of more mechanized products. In order to determine this trend, the ratio of construction to commodities has been computed for each year, and these ratios plotted in the middle curve. The dotted line is a least-square trend.

To show the relationship existing between fluctuations of the ratio and general business, the deviations of the ratio curve from its trend are shown in the lower curves together with a curve of business activity. The most important part of this plot is from 1920 to date. In this period there is a very evident inverse correlation between business and the ratio curve; when business was bad, construction costs were relatively high; when times were good, the gap between construction and other costs was smaller. At the extreme right end, business has reached an all-time low and the construction cost ratio an all-time high. The correlation in the past twelve years has been so marked that it must have some significance. It seems obvious that the business curve will never rise unless the construction-cost ratio curve comes down.



Long-time comparison of construction costs, commodity prices and business activity indicates that the price gap between construction and commodities tends to narrow during periods of good business and inflation. Top curve is a direct comparison of construction and commodity prices. Middle curve is the deviation of the ratio of construction costs and wholesale prices from a least-squares increasing trend of construction costs. Lower curve is the ratio deviation from the trend plotted against business activity.

As has been said, the ratio curve can drop in two ways: either construction cost can be deflated or commodity costs can be inflated. We have discovered that, quite apart from the social desirability of lowering construction costs (and a great deal may be said on that point), it has proved an extremely difficult matter to attain even in the face of the terrific deflation of the past few years. Construction costs are largely composed of items of great stability, among them being two of the most rigid, steel prices and union-labor wages. And as almost everybody would seem to be in agreement that other prices are too low and must be increased, the conditions necessary to lower the ratio curve seem to be well under way without any necessity for any further break in construction costs.

It might be of interest to attempt an estimate of how far commodity prices must rise to enable construction to get started again. The legislation now pending in Washington aims to restore commodity prices to an index of 100. If this is done, the ratio curve will drop well below the average it maintained during the nineteen-twenties when times were good and builders busy.

No builder expects to see construction return to the boom days of six years ago for a long time, if ever, but it would seem that the cost level applicable in those days may soon be reached through the inflation of general commodity prices now contemplated; and with the great barrier of price inequality removed, it is very probable that we shall soon enjoy a marked increase in the volume of construction.

Letters to the Editor

Control Surveys Save Cost

Sir—Your editorial, entitled "The Survey Situation," in the issue of March 30, appeals to me as one that deserves the serious thought and the support of every engineer.

The control system planned by the U. S. Coast Survey, as described by Major Bowie in the same issue of your paper, will, when carried to completion, be of great value to all engineers who base their plans on accurate survey data. By tying the fragmental local surveys of each district to these control monuments of known position, local engineers may correlate in correct relative position all such surveys of the area. Also, the use by private engineers of this control will tend to increase the care and accuracy with which their surveys are made.

There is no valid excuse for the present waste of money in duplication of surveys covering the same area, this duplication arising from the fact that those surveys already made cannot be properly correlated. Mental inertia of engineers toward the control surveys, in not using their influence to push the proposed work of the Coast Survey to rapid conclusion, is the reason for the existence of this wasteful survey condition.

The confusion of data and overlapping of claims, with the attendant crop of law suits and losses, is familiar to all engineers who have had to deal with mining districts, lot subdivisions, land grants and farm surveys, especially in unsectionized sections of the country. A monumented control system, coupled with the requirement that all surveys before they are recorded must be tied to the nearest existing monument, would avoid this confusion and save many times the cost of the control survey.

It is time that the engineers of the country should make a concerted effort to correct a condition that can but reflect discredit to the profession. The way to correct it is to support the effort of Major Bowie to provide a skeleton control system.

Washington, D. C., April 6, 1933. W. N. Brown.

The Schools Will Build Securely

Sir—The excellent discussions by Deans Rogers and Seaton in *Engineering News-Record* of April 6, 1933, raise a number of questions worthy of consideration.

As to management courses: The report of the Hoover committee on "Waste in Industry" emphasized the increasing importance of a trained personnel in management, and for some years the Society for the Promotion of Engineering Education had a committee to present the content of courses in that subject, as well as the methods, both of which were emphasized.

All technological advances demand greater skill in weighing the cost of increased capital against the cost of labor. Management economics is the application of economic law to production. This institution claims to have first organized a four-year curriculum in which these forces were formally harnessed to industrial training. Courses in the essentials of good management are elected by juniors and seniors in civil and other engineering curricula and by those who are not taking engineering. The importance of the essentials of human relations has been recognized here for nearly twenty years.

In addition to the required economics and engineering contracts, the student of civil engineering may take business law, engineering management, cost-keeping for construction and engineering economy. These subjects give him an introduction to the business aspects of engineering.

Also, the school of engineering has believed in giving the able senior student an opportunity to develop himself by undertaking special problems, by the seminar method or by individual consultation. Furthermore, a student is given latitude in his elections of subjects, outside or within the school of engineering. We consult his tastes, his needs and his probable future field of usefulness.

We shall continue to strengthen the foundation of English, mathematics, science and the technique of engineering. Emphasis on the basic principles will continue to be the cornerstone, or rather the whole footing course. It is founded on sound engineering bedrock, and I see no reason to change the density of the mixture or weaken the superstructure where it is illustrative of the applications of principles to one or another field.

Graduate study has attracted an increasing number. Discrimination should be employed in selecting those who by ability may profit most by advanced instruction. To encourage those who are not scholarly leads to a depreciated quality of achievement and a lowering of standards of method as well as of content. Graduate instruction, if well done, is expensive.

Graduate instruction in engineering fields is closely related to research, although much of the latter has been carried on by full-time investigators. Our research laboratories have a twofold function: first, to train promising graduates in the technique of thorough, accurate investigations; and, second, to secure additional knowledge.

Industrial cooperation designed to yield profitable products or processes has been reduced in many institutions. Where it is essentially commercial in its objective it is of questionable value to the institution and of doubtful ethics. The most important fields of research have been supported in an admirable manner under difficult conditions, both in industry and in colleges and universities. This evidence that many industries appreciate the contributions that institutional research may make and has made is heartening. It will be unfortunate if our facilities are suffocated by the demands of economy, although they must accept their share in a reduced budget.

Confidence in past performance and in present essentials are necessary in the midst of the hasty proposals made for drastic curtailment or abandonment of that which has proven sound in the past. Constant constructive improvement is wiser than spasmodic expedients for temporary relief. The engineering profession will retain its essential honesty and sanity in the midst of confusion. The engineering schools will continue to think clearly and to build securely. R. L. Sackett.

Pennsylvania State College, State College, Pa., April 12, 1933.

Engineering News-Record

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Bay Bridge Work Begins

FOR MONTHS construction has not received news as heartening as the announcement of contracts totaling more than $35,000,000 for the San Francisco-Oakland Bridge. The work thus initiated will produce a stimulation in construction activity that will be felt all the way from the ranks of local labor to the distant shops of materials and equipment makers. The undertaking is a public-works project in the truest meaning of the term; it has meritorious need, extends large public benefit, is self-liquidating and distributes work widely. Regardless of these commendatory features it would have remained waiting for financing but for national backing through the R.F.C. loan. The San Francisco-Oakland Bridge is an excellent example of the type of public-benefit project that can be started in increasing number with the establishment of a definite public-works program.

Less License Money for Roads

ABOUT a third of the state legislatures that have adjourned their sessions have enacted laws affecting motor-vehicle license rates. According to the records of 29 adjourned legislatures compiled for the Association of State Highway Officials, ten have changed license rates. The count is interesting. Five states have reduced all car rates from 25 to 50 per cent, two have reduced passenger car and increased truck rates, one has reduced and one has increased truck rates, and one has reduced automobile rates only. In the main these actions are the beginning of a reaction against diversion of road revenue to other purposes than road maintenance and improvement. In some states the curtailed fees will reduce highway funds to barely enough for moderate maintenance of the roads now improved. Added to increasing diversion of gasoline taxes to pay doles and a falling off of 7 per cent in car registrations and gasoline consumption, these new license acts mean a growing danger to satisfactory progress of the highway system. The transportation engineer and the roadbuilder may well take them as a warning, and as a powerful incentive to organizing effectively for battle to defend and develop highway transportation. Spasmodic and separately directed efforts accomplish little.

Making Schools Safe

SCHOOL construction in California has been placed under supervision of the state by an emergency act just passed as a sequel to the Long Beach earthquake. In the light of the damage sustained there by school buildings the assumption of authority by the state in the interest of public safety cannot be questioned. Those who would point to the establishing of another bureaucratic agency must admit the past failure of the smaller governmental units to require adequate construction. There are ample precedents for such state supervision, among them California's own dam-control act of four years ago, now functioning most effectively. Be it noted, however, that any control of the kind is only as good as its administration: the law can provide authority, but it alone will not make the buildings safe. The key is efficient administrative control. Well administered, the new law will protect life and property with due regard for the balance of economy.

Creditable Grading Research

A PRAISEWORTHY attempt to rationalize equipment selection by an analysis of road-grading operation is reported in this issue. Roadbuilders perhaps will be most generally interested in comparing their own experience with the specific job values given for the 30 grading jobs analyzed, but the broad question of developing a rational curve of what percentage of excavating volumes may be expected to occur in shallow and in deeper cuts is important to all concerned with earthmoving. If, as shown by the curve worked out from the 30 projects analyzed, 40 per cent of the excavation per mile is in cut less than 4 ft. deep and only 8 per cent is in cut greater than 20 ft. deep, a very definite indication is given of the type of grading plant that the general contractor should possess. Whether or not the roadbuilder be prepared to follow the author's theory to its more complete application, the theory gives him excellent opportunity for a type of study which has not been too much in evidence in road-grading practice. In any event, credit for performing a tedious and useful task is due the author and the equipment manufacturers and highway officials who have made his long labor possible.

Building Modernization

A BETTER appreciation of the economic importance of modernizing old buildings is one of the constructive developments of the depression. Activity has responded to this appreciation until building alteration work has assumed major importance to the architect and the engineer, whose field of activity has been almost devoid of other new construction. Modernization work has always been economically sound but has never been practiced on a large scale before, first because tenants were satisfied with old standards and second because funds were readily available for constructing new buildings. Neither of these factors has its former potency. There is an abundance of space in modern buildings, and it exerts a powerful suction on tenants in low-standard quarters. Owners of old buildings, not able or willing to build new ones, must modernize or lose tenants. And they are finding that the old buildings have many years of life in them yet. For the engineer and the architect the work presents a somewhat new set of problems. Usually it must be carried out under cramped conditions, often with the building occupied and always without damage to the existing structure. Such work brings out much design ingenuity that has been in danger of rusting away from lack of use. Building modernization will increase because it offers the building owner one of the few profitable investments available. And socially it is equally desirable for the employment it provides the suffering building-trades workmen.

What Public Works?

AT WASHINGTON a committee of high government officials is at work developing a public-works program. In the meantime the conviction that public works are the only effective weapon for the attack on unemployment has become virtually universal. Economists and business men now agree that the fifteen millions of idle represent a problem too large and too acute for further temporizing.

One critical question remains: Where are the public-works projects that can be undertaken at once? As a noted economist put it last week, "Are enough such projects ready for construction that anything like a million men could be put to work quickly?" Business and industrial men have asked the same question. The answer is yes. And the proof will be easily appreciated.

These projects, however, are not to be sought in federal construction, for its amount is too small and it cannot be expanded quickly enough. Nor is there hope in optimistic billion-dollar dreams such as coast-to-coast superhighways. The ready works are the deferred state and city projects of the last few years.

A few simple figures should be recalled. The normal year's program of public-works construction in the United States is about three billions. Nine-tenths of this sum consists of state and local construction. During the last two years, a shrinkage of more than two billions took place in this field. Sharp decline began in 1931, and the 1932 program was cut in half. An incomplete list of deferred projects compiled a month ago—the great majority capable of completion within a year—totaled two and one-half billion dollars.

This huge volume of work is ready. Translated into employment it means at least a million and a half men returned to work, on the job and in the supply factories. As every city, county and state is involved, mobilization of the waiting projects will at once spread its benefits over the whole country.

Plans for much of the work are ready; others, set back by dismissal of engineering staffs, will require some weeks of intensive work to bring them to contract stage. But with a will, and with full local cooperation, this can be accomplished, and in three months the majority can be under construction.

Thus, so soon as definite financing of the work is assured by the national government, employment can begin in every state and city that is prepared to take its part in the campaign of recovery.

Railroad Coordination

THE ADMINISTRATION'S railroad coordination bill is commendable in that it does not attempt to settle all the railroad problems by specific enactment. Instead it gives broad powers to the coordinator and to the regional boards and leaves the details for them to work out. The bill appears, however, to lack some elements needed to make it fully effective.

In the first place, the bill makes no definite provisions for injecting the leaven of new thinking into the regional boards. They are to be made up of railroad men, presumably, as they are to be picked by the railroads of each region. One or two men of transportation experience outside the railroad organizations sitting on these boards might have the temerity to challenge many railroad traditions.

Passage of the thirty-hour-week bill doubtless will add materially to the problem of the railroad coordinators as it will increase the railroad wage bill, already 65 per cent of the total operating costs, but it also will make possible the consolidation of services that could not otherwise be consolidated because of organized labor's opposition to the wholesale laying off of men involved. As essential services will require more men under the thirty-hour-week law, men now engaged in duplicate or unnecessary services can be transferred to the ones maintained as essential. The pending legislation, therefore, should give the coordinating committees definite powers to deal with the labor questions that will be raised if the thirty-hour-week legislation is passed.

To be fully effective, the coordinating committees not only must be able to order the expenditures involved in combining services or in adding needed ones but must also be able to obtain the money. As in most instances the railroads cannot now finance new equipment or construction, such financing will need to be arranged through R.F.C. loans, or possibly through assistance to be provided by the pending public-works legislation.

These are elements of the railroad coordination problem that need consideration when Congress takes up the proposed legislation. The coordinator and his regional boards have a difficult task before them. They should not be handicapped by failure now to supply them with all available means of accomplishing that task.

Rising Costs

THE EXPECTED and promised authorization of the President by Congress to bring about price reflation is nearly an accomplished fact as we go to press. Now is to come the double test of its effectiveness in the field of engineering construction and employment of the idle workers—whether it will cheapen money and raise material prices, and whether through this effect it will increase construction volume.

Since 1929 the claim has been often repeated that construction costs must be brought down before construction volume could increase. It may not be necessary to put this claim to direct test, for if the money-management clauses of the farm bill are effective in raising commodity prices, they will lower the value of wages by decreasing their purchasing power and so will lower construction costs relative to general costs.

Last week's rise in commodity prices, though in large part speculative, has been paralleled by a rise in the prices of many construction materials and a resulting increase of the *ENR* construction-cost index of over four points, or nearly 3 per cent. This jump is in no sense speculative, we believe, but represents a determination on the part of producers to stop doing business below cost at the earliest possible moment. Contract bids are bound to stiffen correspondingly. Contractors cannot long continue to bid at a loss.

The wise contractor therefore will count on higher prices rather than lower. Indeed, bids are apt to rise faster than the relative increase of the construction-cost index. The probable course of construction volume also is upward, both because of the expected administration construction program and because of the certainty that such building as has been deferred for some years because of declining prices will be put under contract immediately, once there is definite prospect of a continuing cost rise.

NEWS OF THE WEEK

Contracts Let for Bay Bridge at San Francisco

FOLLOWING a favorable decision of the supreme court of California on the legality of the bonds of the California Toll Bridge Authority and final approval of a loan by the R.F.C., the state director of public works, on April 26, let six contracts totaling $36,841,317 for the construction of the bridge across San Francisco Bay from San Francisco to Oakland. Execution of contracts is expected to be completed within a few days and actual construction work should be under way by the first of June. The contracts were all awarded to low bidders, as follows:

West Channel Substructure—Transbay Construction Co., $6,957,100.
East Channel Substructure—Bridge Builders, Inc., $4,495,854.
West Superstructure—Columbia Steel Co., $13,732,471.
East Superstructure—Columbia Steel Co., $8,798,096.
Yerba Buena Tunnel—Clinton Const. Co., $1,821,292.
San Francisco Anchorage—Healy-Tibbitts Const. Co., $1,036,500.

A loan of $61,400,000 to the bridge authority was approved by the Reconstruction Finance Corporation last year, provided the state would build the approaches, include the bridge in the state highway system and reimburse the bridge authority for the $650,000 spent on preliminaries. Early this year (*ENR*, Feb. 2, p. 171) the state legislature made the necessary commitments for financing the approaches and since then bids on the major items of construction have been taken by the Toll Bridge Authority so that contracts will be let at the earliest possible date. Also, a friendly suit was instituted by the Director of Public Works in order to determine the validity of the bonds of the Toll Bridge Authority. The suit was concluded on April 20 when the state supreme court approved of the bonds.

C. H. Purcell, chief engineer, who made the final arrangements with the R.F.C. in Washington is scheduled to return shortly after completing financial negotiations.

Studies Begun for Sewage Plant for Minneapolis and St. Paul

Following the legislation creating a sanitary district for the cities of St. Paul and Minneapolis, approved in April (*ENR*, April 20, p. 542), examination of the route of the proposed joint interceptor sewer has been begun and the State Board of Health has commenced its study of pollution conditions in the river. Actual construction of the joint sewage disposal plant cannot be undertaken until the board has completed its study and declared that a nuisance exists. The study is expected to take about 45 days.

Contracts Totaling $7,325,000 Let for Aqueduct Tunnels

Directors of the Metropolitan Water District of Southern California, on April 21, awarded contracts totaling $7,325,081 for the construction of fourteen and six-tenths miles of full-capacity, 16-ft. diam. tunnels for the Colorado River aqueduct project. Three tunnels, the Iron Mountain, Coxcomb and Cottonwood are included in the contracts. District expenditures for materials and other items will bring the cost of the three tunnels to $9,136,231. Winston Brothers and the Utah Construction Company received the contract for the Iron Mountain portion of the job. Winston Brothers will build the eastern section, at a figure of $2,143,799. The Utah Construction Company's bid for work on the western section was $1,699,705. Winston Brothers also were awarded the Coxcomb tunnel contract, on a bid of $1,624,515. The J. F. Shea Company, bidding $1,857,062, was awarded the Cottonwood tunnel contract.

County Road Work in Illinois Depends on Sales Tax Decision

County road work in Illinois will be seriously curtailed if the state sales tax of 3 per cent, which has been taken under advisement by the Illinois supreme court, is held invalid. The tax became effective April 1 and almost immediately was found unconstitutional in the circuit court at Edwardsville. An appeal now has been taken to the state supreme court. If no money is to be derived from the sales tax the county will have to continue to depend for money for unemployment relief on diversions from the gasoline tax fund.

Washington Notes

By Paul Wooton
Washington Correspondent

Appointment of an administrator of public works and the transfer of various public works activities to the Interior Department was foreshadowed when Secretary Harold L. Ickes was chosen chairman of a cabinet committee to head up the public works program. The plan is to have a lump sum, probably not to exceed $3,000,000,000, made available for public works. The allocations will be made from time to time by the administrator as conditions warrant.

It is known that substantial allocations for highway construction and flood control work already have been agreed upon.

The money is to be concentrated on projects that are in a position to begin employing men at once or in the near future. Little, if any, of the proceeds of the public works bond issue will be made available for surveys or the preparation of plans for projects that will not produce direct employment before winter.

Federal-Aid Public Works Urged by A.G.C.

A $3,000,000,000 federal and public works program was supported by resolution of the governing board of the Associated General Contractors of America at its meeting on May 1, in Washington, D. C. The association, it was stated, has worked with the trade recovery committee of the Construction League and with the committee of federal department heads to coordinate legislative proposals and as a result the board was reasonably certain that federal-aid public works legislation would be forthcoming. The amount of this federal aid, the methods of financing it and the provisions for its use could not, however, be reported. It was possible to state that the administration was alive to the necessity of quick action and that planned action would soon be laid before Congress.

The major discussion of the meeting following that of public works ranged around relations with the surety bonding companies. Reporting that unsatisfactory results had followed from recent joint committee deliberations, a resolution was passed requesting the Construction League through its civil engineering and architectural affiliates to formulate a form of surety bond which could be adopted by the construction industry. Resolutions were passed condemning the diversion of gasoline taxes to other purposes than highway improvement, recommending trade practice codes to reduce bid chiseling, supporting consolidated appraisals as a requirement in marketing building bonds, and the formation of state construction councils around present state trade recovery committees to survey opportunities for public works construction to relieve unemployment.

New Topographic Survey Favored in State of Massachusetts

A bill advocating a new topographic survey of Massachusetts was sponsored before the legislative committee on ways and means at a hearing in Boston last week by Kirtley F. Mather of the Harvard University department of geology; F. K. Morris, Massachusetts Institute of Technology; Arthur D. Weston, director of the state division of sanitary engineering and many representatives of commercial organizations. The total cost, spread over ten years, would be $750,000, of which half would be borne by the federal government. The bill provides that the Massachusetts department of public works would appropriate $25,000 out of the highway fund this year for the survey. It was urged that the bill would aid forestry, engineering projects, tax assessments, town planning and development in addition to being of historical and educational value. There was no opposition to the measure.

Wide Power over U. S. Railroads Proposed in Federal Legislation

Very broad powers over the railroads of this country are granted to the federal coordinator of transportation in the Administration's railroad bill which is expected to be presented to Congress this week.

The pending bill creates the office of federal coordinator of transportation, with authority to divide the railroads of the country into three groups, eastern, western and southern, and authorizes the railroads of each group to set up regional coordinating committees. These committees are directed to bring about the objectives of the act by voluntary action of the railroads concerned wherever possible, but where voluntary action is not possible the federal coordinator, if he approves the proposals of the regional committee, may order the work carried out.

The objectives of the act are: Elimination of unnecessary duplication of services, stimulation of the use of joint facilities, prevention of impairment of income through accessorial services, avoidance of waste through disturbance of rates, promotion of financial reorganization consistent with public interest, and study of means of improving transport conditions and preparation of plans therefor.

The orders of the federal coordinator are exempted from the provisions of the anti-trust law and the Interstate Commerce Commission is required to give him what assistance he requires in carrying forward his work. His orders may be set aside by the commission after investigation.

The act is made effective for one year after its passage.

Lincoln Park Seeks R. F. C. Loan To Build Sewage Disposal Plant

As a step in compliance with a circuit court order making it mandatory for the city of Lincoln Park, Mich., to build a sewage disposal system, that city will make application to the Reconstruction Finance Corporation for a loan of $165,000. The court order against the pollution of Ecorse River, the present outlet for sewage of Lincoln Park, was issued under the terms of the 1929 revision of the state law governing water pollution control.

According to the terms of the governing act, one year following the date of issue of the order is allowed for the preparation of necessary plans and pollution is to be stopped not later than the end of the second year following the court order. The date of issue of the order affecting Lincoln Park makes mandatory the construction of the disposal system by the end of 1933.

The sewage disposal system planned at a total cost of $165,000 includes sanitary interceptor sewers, pumping station and an outfall sewer to the Detroit River. Approximately 6,000 ft. of sewer is involved.

The loan is asked on the basis of a self-liquidating public utility project, service charges to be based upon the water consumption by users of the system.

Plans and specifications and estimates were prepared by Pate, Hamann and Hirn, consulting engineers, Detroit, who are city engineers for Lincoln Park. Plans have been approved by the Michigan department of health.

R.F.C. Makes Loan To Repair High Dam Near Phoenix, Ariz.

A LOAN of $1,350,000 to the Maricopa County Municipal Water Conservation District No. 1 at Phoenix, Ariz., has been approved by the directors of the Reconstruction Finance Corporation. The money is to be used for the repairs to Lake Pleasant Dam on the Aqua Fria River and to replace wood flumes in the district irrigation system with concrete and steel.

The Lake Pleasant Dam was completed in 1927 (*ENR*, Feb. 2, 1928, p. 180). It is a multiple-arch structure 170 ft. high above stream bed and over 2,000 ft. long. Soon after it was completed, serious cracks developed in the buttresses and in 1929 the spillway crest was lowered 24 ft. following a report on the safety of the structure by a board of engineers (*ENR*, Feb. 14, 1929, p. 275).

The district will organize an operating and construction company to which will be delivered all power rights, title to 15,000 acres of land in the district, and the proceeds of the loan. This company, in turn will reinforce the buttresses, raise the spillway, and install tainter gates to provide better regulation and will operate as a non-profit municipality under state control.

Other loans authorized

A loan of $16,500 to the village of Hatch in Dona Ana County, New Mexico, has been authorized by the R.F.C. to finance the construction of a water supply system. Montezuma, Iowa, also had its application for a $9,700 loan approved. It will use the money for water supply purposes.

Agree on Niagara bridge plans

Preliminaries to the start of work on the Grand Island bridges near Buffalo, N. Y., have been advanced by an agreement between the Niagara Frontier Bridge Commission and Frederick Stuart Greene, superintendent of public works, New York, as to the method of preparing plans for the bridge. Under the agreement all work on the bridge is to be supervised by the state department of public works. Plans for the substructure are to be prepared by the engineers of the public works department and the superstructure is to be designed by the firm of George B. Diehl, Inc., Buffalo, with Waddell & Hardesty, New York as consultants.

Legal and financial aspects of the bridge project have been approved by the advisers of the R.F.C. and approval of the engineering board is expected soon. It is understood that final approval by the directors of the R.F.C. now depends upon definite assurance from the state and county that the park and parkway program on Grand Island will be carried out so that the bridges can be put into full service as soon as completed.

Engineering board operations

An increasing proportion of the time of the Reconstruction Finance Corporation's engineering board is being consumed in following up the projects which are in the course of construction. The board is checking carefully the progress of the work to make sure that the plans are being followed and that expenditures are being made in accordance with the agreement.

New applications continue to come in at the rate of about ten per week. Consideration of the questionable ones requires much more time than those that come clearly within the law. Even when it is obvious that a project cannot be made self-liquidating, or where there is question as to the security offered, it usually is necessary to consider and reconsider before the applicants can be convinced that approval cannot be secured. About 60 per cent of the applications now being received are for water supply projects.

Bridge loan advanced

Final approval of a $3,000,000 loan to the New York State Bridge Authority for the construction of the Catskill bridge was given by the directors of the R.F.C. on April 29. Approval followed the execution of an agreement between the state and the bridge authority whereby the state will take $200,000 of the $3,200,000 bond issue of the bridge authority to finance the bridge.

School Building in California To Be Regulated by the State

All school construction in California, including alterations costing over $1,000, must be approved by the state as to plans and specifications as the result of an act passed as an urgency measure by the state legislature following the Long Beach earthquake. Authority for approving plans is vested in the division of architecture, Department of Public Works, under the police power of the state. Supervision will include both approval of plans and inspection during construction and the cost will be met by fees to be paid by the school boards submitting the designs.

Plans sent to the state office for approval must be prepared, according to the law, by a certified architect or by a structural engineer who has been authorized to use the title "structural engineer" by the board of registration for civil engineers. Drawings are to be accompanied by all computations and stress diagrams so that they can be readily studied and interpreted. Wherever unusual conditions occur additional data may be requested.

The fee required by the act is ½ of 1 per cent for the first $250,000 of estimated cost and ¼ of 1 per cent for all costs in excess.

The division is authorized and required to make such inspection and examination necessary to secure enforcement of the act and conformity to the plans and specifications as approved. Inspection is to be adequate and continuous and the inspector "shall be a person or persons not less than 25 years of age who has or have had at least three years of experience in building construction, one year of which has been in concrete construction, and shall be some person or persons not in the employ of the contractor." The inspector is to act under the direct responsibility of the architect or structural engineer and shall be acceptable to the division.

Upon final notice of completion the division will issue a certificate of approval and no building on which work has been done in accordance with this law is to be used until such approval has been granted.

Upon request of any school board or of at least 10 per cent of the parents having pupils enrolled in the school district the division of architecture is required to

make an examination and report on the condition of any school building. A fee to cover examination is to be paid by the applicant but this may be waived when it appears that the financial condition of the district does not permit of the expense involved. All records of school construction accumulated under the provisions of the act are to be public documents.

For the guidance of school boards and designers the division has adopted rules and regulations covering structural design and materials, taken in their entirety from the uniform building code, California edition, as adopted by the joint committees of engineers, architects, contractors and other groups working in conjunction with the uniform building code executive committee of the state Chamber of Commerce.

George B. McDougall is state architect and chief of the division of architecture. C. H. Kromer is principal structural engineer and will be in direct charge of carrying out the provisions of the act.

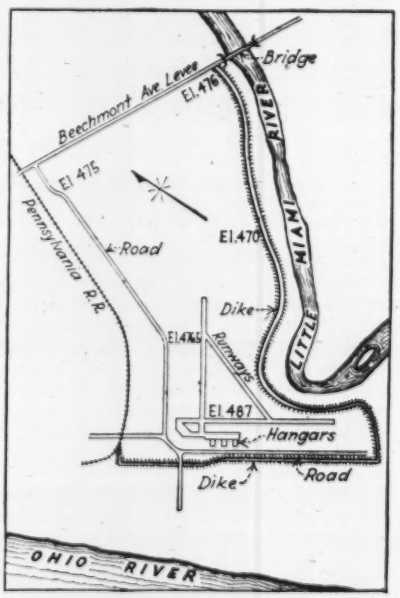
Masonry Code at Long Beach Revised by Inspector's Order

As a result of the March 10 earthquake which wrecked many masonry walls in Long Beach buildings, C. D. Wailes, Jr., chief building inspector of the city, has issued a brief specification, whose effect is to revise masonry construction practices on all new and repair work in the city. Several important changes from the stipulations of the old building code are involved. The new order specifies portland cement mortar exclusively, allowing a small proportion of lime for workability; lime and lime-cement mortar, previously permitted, are eliminated. The new order requires one header course in every four courses as compared with one in six previously. Whereas the old code required parapet walls on masonry buildings to be at least 30 in. high above the roof and when the height exceeded six times the thickness that they should be laterally supported (method not outlined), the new order states that all masonry parapet walls shall be not less than 18 in. and not more than 36 in. high above the roof and that a horizontal belt course tie of reinforced concrete shall be placed at the top of all parapet walls; minimum reinforcement shall be a continuous ½ in. square bar. The ties must be not less than one course of brick deep and at least 8 in. wide. All masonry parapet walls must be reinforced vertically with ⅜-in. round bars 12 in. on centers, extending into the belt course tie below and hooked around the horizontal reinforcing bar in the top tie. Such vertical bars shall be placed 4 in. from the roof side of the wall. The order also requires horizontal belt course ties of concrete to be placed under the floor joists of each floor above the first and under the ceiling joists or roof rafters. The depth of such horizontal ties must be equal to at least four courses of brick and their width shall be at least equal to the wall thickness minus the width of a brick but in no case less than 8 in. Lintels over openings more than 4 ft. wide which are of structural steel shall be encased over the top and sides with concrete. Vertical ties are required at each corner of a building and not more than 50 ft. apart in the walls; they must not be less than 8 in. in any dimension and in no case less than 4 in. thinner than the wall. Relative to workmanship the order requires full-shoved mortar joints and that all masonry units be thoroughly wetted not more than one hour before laying and that they shall be damp at the time of laying.

Additional Dike Protection for Cincinnati Airport

Protection of the Cincinnati municipal airport from Ohio and Little Miami River overflows, which breached the dikes during the recent Ohio River floods, is proposed in a plan recently reported by Edgar Dow Gilman, director of public utilities, Cincinnati, Ohio. By this plan the anticipated frequency of flooding would be an average of once in 11½ years and the average period for which the airport would be out of service would be 15 days for each flood.

The accompanying plan shows the airport in relation to the two rivers and with the present system of protecting dikes. It is proposed to reconstruct the Little Miami and Ohio River dikes to elevation 494½, corresponding to a flood height of 62½ ft., Cincinnati gage, and strong enough to resist a static head to the dike top. The levee carrying Beechmont Ave., is to be raised to elevation 495½, or 1 ft. higher than the river dikes to provide for the building up of the pool level north of the levee due to the restricted get-away channel at the roadway bridge. To provide safety to the dikes in case of overtopping floods, a controlled spillway south of the bridge in the Little Miami dike is to be constructed. By this spillway, in times of danger, the airport would be flooded to drown out the flood head and hold the dikes.



Cincinnati municipal airport

For operating purposes it is suggested that three gages be established and weather bureau and other connections be made which will enable the airport operators to put the spillway in operation for a reasonable period before overtopping flood crests are anticipated.

New River Power Controversy Taken to Court of Appeals

The United States district court in Richmond, Va., has granted the Appalachian Power Co. an appeal to the U. S. circuit court of appeals from the district court's recent decision in favor of the Federal Power Commission in the controversy between the company and the commission over the commission's claimed right to supervision over its power development on the New River in Virginia. (*ENR.*, April 6, 1933, p. 446).

Because of the importance of the case as determining the right of the Federal Power Commission to take jurisdiction over hydro-electric plants built above the navigable reaches of rivers, it is expected that the case ultimately will go to the United States Supreme Court. The company, with the support of the State of Virginia, claims that because the New River is not actually navigable, it is not required to seek a federal license with all the commitments that go with such a license. The power commission, on the other hand, claims that as the New River is a major tributary of the Kanawha River, a navigable stream, the construction of power plants upon it comes within the jurisdiction of the commission.

Mead Intervenes in Controversy Over North Platte River Water

In an effort to bring about an agreement in the long controversy between the states of Wyoming, Nebraska and Colorado over the diversion of water from the North Platte River, Elwood Mead, U. S. Commissioner of Reclamation, has written to Governor Johnson, of Colorado, urging Colorado to accept the plan for diverting 30,000 acre-ft. from the North Platte into the Poudre valley. Construction of the Casper-Alcova irrigation project in Wyoming hangs on settlement of the water controversy. Wyoming proposes to build a large reservoir to impound the flood waters of the North Platte River, a reservoir larger than is required for the 63,000 acres in the irrigation project, and has proposed to the other two states that they agree to a diversion from the North Platte River into the Poudre valley the entire amount of the surplus storage, estimated at about 30,000 acre-ft. a year, without charge to either state, making this water available for use in Nebraska as an equivalent for the diversion by Colorado of 30,000 acre-ft. Colorado has not agreed to the plan.

Bids on Hoover Dam Cement

The California Portland Cement Co., the Riverside Cement Co., the Monolith Portland Cement Co., and the Southwestern Portland Cement Co., jointly have submitted a bid of $1.55 a barrel for 400,000 barrels of cement, to be used in the Hoover dam. The Union Portland Cement Co. of Denver, bid on only 50,000 barrels and its price was $1.39 a barrel. The cement is to be made to specifications developed by the U. S. Bureau of Reclamation to minimize the effect of heat generated during setting.

Major Somervell Goes to Turkey

Major Brehon B. Somervell, district engineer, U. S. Engineer Corps., at Memphis, Tenn., has been given a leave of absence from the army and has left for Turkey where he will act as assistant to Walker D. Hines in an economic survey of that country.

Major E. C. Kelton will have charge of the Memphis district office during Major Somervell's absence.

Large Street-Widening Scheme Approved for Mexico City

Widening of San Juan de Letran Street, an important thoroughfare of Mexico City, to 35 meters, has been approved by the municipal government of the federal district. The street has long been badly congested. Widening will cost about 3 million pesos, exclusive of damages to buildings and the cost of reconstruction, which is estimated at 12 million pesos. Included in the work is the purchase of the Guardiola Palace, a structure built more than two centuries ago, and its demolition to provide site for a public park.

New Water Supply Planned for City of River Rouge, Mich.

The city of River Rouge, Mich., acting in conjunction with the Michigan Committee for Trade Recovery, has filed application for a Reconstruction Finance Corporation loan of $380,000 to finance construction of an independent water works system to furnish the city's water, now purchased from the Detroit department of water supply.

The proposed plan provides for filtering water drawn from the Detroit River and pumping it through new supply mains to the existing distribution system. The total project, estimated to cost $380,000 and planned as a self-liquidating project to lower the cost of water to consumers and as an unemployment relief measure, provides for taking the supply through a submerged intake crib in 40 ft. of water and through 1,600 ft. of 20-in. cast iron intake line to a city-owned site of 4½ acres at the foot of Coolidge Highway and the Detroit River. The filtration plant will be of the rapid sand filter type with a daily capacity of 4,000,000 gallons. An underground clear water storage reservoir of reinforced concrete having a nominal capacity of 1,000,000 gal. a structural steel frame building 75x100 ft. in plan and estimated to cost $37,000 to house the filters, pumps and mixing chamber and nine motor-driven centrifugal pumps with capacities from 700 to 4800 g.p.m. are included in the work.

Preparation of the site will include construction of a reinforced concrete sea wall 825 ft. long supported on timber piles and sheeting, and placing of 60,000 cu.yd. of earth fill. The connecting water supply line will require 6,000 ft. of 20-in. and 1,500 ft. of 12-in. cast iron pipe.

Plans and estimates were prepared by the city engineers of River Rouge, Mason L. Brown and Son, Detroit. Plans for the system have been approved by the Michigan department of health.

Welding Society Holds Meeting in New York City

MEETING in New York on April 27 and 28 in its fourteenth annual convention, the American Welding Society adopted a new welding-wire specification, departed from precedent in devoting one session to general economic and business conditions, at which the speakers were Charles F. Abbott, executive director, American Institute of Steel Construction, and Willard Chevalier, publishing director, *Engineering News-Record*, listened to a lecture by F. P. McKibben on structural welding, conferred the Samuel Wylie Miller medal for meritorious accomplishment on H. H. Moss, of the Linde Air Products Co., well known for his work on structural welding with oxy-acetylene, and re-elected Mr. McKibben president and J. J. Crowe first vice-president. The attendance was small.

Welding-wire specification

The welding wire or "filler metal" specification was probably the most important accomplishment to come out of the meeting. It will be available in printed form within a month or two. The specification differs from the existing specification in that it is based on the performance and results to be obtained from the filler metal rather than upon the chemical composition and physical properties of the wires themselves. A tensile test is required in which the weld must show a strength from 85 to 100 per cent of the base metal, depending upon the filler metal used. In a free-bend test the per cent elongation is required to be 7 per cent for minimum-grade filler metal and up to 30 per cent for the highest grade. A nick break test is also required for some of the filler metal types. No differentiation is made between wire for gas welding and electrodes for arc welding. The specification has been made necessary for a variety of reasons, the most important of which is the rapid development of patented coated and covered electrodes which could not be specified by composition because they vary so widely.

Development of new fields

Mr. Abbott devoted his address to a discussion of the importance of the trade association in business revival. He urged an appreciation of the importance of cooperation through the trade association which is the only contact that an industry has with the government and the public. He pleaded for adequate prices and against the practice of price cutting below cost. Too many executives, he said, are production minded in spite of the lessons taught by the depression concerning over-capacity. Consequently they still are willing to spend a great deal of money in plant extensions but very little in market development which is the more important.

Mr. Chevalier's address was on the subject of welding as a factor in industrial revival. Welding's relation to business revival, he said, may be summed up in three words—adaptability, novelty and economy. Much of the excess plant capacity referred to by Mr. Abbott has been caused by the inflexibility of industry. Huge plant investments are made which are good only for a certain product and a certain method of manufacture. Therefore when new processes are developed new plants must be built to accommodate them. The result has been a ruinous excess capacity whereas with some flexibility of operation, the existing plants would have been able to change over to accommodate the new processes instead of forcing them to build competing plants. Welding has the characteristics of flexibility and adaptability that have been needed and that should be utilized in combating this evil.

An aid to revival

Welding may contribute to a revival in both consumer and producer goods, said Mr. Chevalier. The large deferred demand in consumer goods will be met by those products which are cheap or new. Welding has demonstrated its economy of metal in many applications, thus contributing to low cost, and the new forms of products it makes possible assure a novelty that will appeal to buyers. With respect to producer goods, the manufacturer, if he hopes to sell in the new business revival, must obsolete the existing equipment in his customers' hands by new products that are plainly superior. In doing this, too, he should be careful not to standardize too quickly, but to keep his plant and his product flexible so that his investment may not again become frozen and unprofitable. Too many industrialists, in Mr. Chevalier's opinion, still think of welding as a repair method, useful for making old equipment usable. This attitude must be changed so that welding will be looked upon as a creative process, if welding is to take a prominent part in business revival.

Welding practice

Mr. McKibben's lecture covered many phases of structural welding procedure and practice. Sections of it were devoted to typical structural details, methods of strengthening bridges by welding, to new steel bridge floors, to methods of estimating welding, and to the importance of theory and methods of stress analysis. Mr. McKibben urged that the welding profession should take the initiative in licensing or controlling welders, pointing out that there are in existence several legislative proposals to license welders, and that such restrictions as they would set up are not in the public interest and would increase costs. Welding safety, which is what the legislatures have a right to be interested in, should be made the responsibility of the welding contractor who is in the best position to control his welders.

At the present time, according to Mr. McKibben's compilations there are 126 cities which permit welding of steel building frames, New Orleans with a population of 456,000 being the largest, although Cincinnati, the last to be included on the list, is of practically the same size. In addition to these cities, special permits have been issued in Boston, Los Angeles and San Francisco for welded buildings. Welding is permitted by the proposed new building codes for New York and Chicago. Mr. McKibben pointed out that there was no reason for codes to go into detail when welding was included. It is necessary merely to provide that welding be permitted in accordance with the American Welding Society code.

In addition to the voluminous data contained in the paper, Mr. McKibben emphasized three important points. In the first place both bare and covered electrodes are suitable for structural welding. This has

not always been the case inasmuch as the covered wires could not stand rough field handling. These difficulties have now been overcome and covered wire may often prove the more economical. It produces welds of greater strength and ductility than those made with bare wire and, although it costs more, its use may effect a net saving because of the increased welding speed permitted. Mr. McKibben expressed interest in obtaining information with regard to the strength of resistance or pressure welds in shear. Most resistance welds are stressed most highly in shear and yet there seems to be very little data available.

It was stated in discussion that resistance welding equipment is available for welding two plates up to ½ in. in diameter. Resistance welding offers many possibilities but the equipment is expensive and heavy and probably not suitable for field work. The final point made by Mr. McKibben was that the qualification tests be simplified or reduced to two in number, namely, the wedge test and the tension test with an end-fillet specimen.

Contractor Wins Test Case in Arkansas Highway Suit

The supreme court of Arkansas, in a decision rendered April 24 in a case brought to test the validity of contracts awarded by the highway department on a non-competitive basis, held that the contractor is entitled to payment for the fair value of the work performed under the contract awarded by the former state highway commission. The judgment was in favor of W. W. Keaton for $6,722, and is one of a number of cases growing out of the state's refusal to pay upon contracts awarded on a non-competitive basis. In its decision the court said, "We conclude that a benefit having been received, which cannot be returned, which was derived from an agreement between parties having power to make it, which was neither illegal nor immoral nor in violation of public policy, but which agreement cannot be enforced according to its terms because not made in manner and form provided by law, a recovery was properly permitted."

Water Bill Delinquents to Work on Conneaut Supply System

Exchange of labor for municipal services is to be effected in Conneaut, Ohio, as part of the city's program for laying about two miles of 16-in. water mains to connect the existing distribution system with a new filtration plant to be built this summer. The labor force will be recruited from those who are delinquent on their water bills, selecting first unemployed delinquents who rent their houses, second, unemployed delinquents who own their own homes, and, third, other delinquents who are only working a few days each month. Preference is given to those who rent their houses on the ground that a landlord who furnishes a house should not be taxed with the water bill also. The first two classes will receive about half of their pay in cash, and the other half in credit on their bills. The third class will be required to apply all their wages to their bills.

The city will purchase the materials required for the work.

Large Shipbuilding Plant Proposed for Pensacola, Fla.

The Gulf Industries, Inc., has received a franchise from the State of Florida for the construction of a shipbuilding plant and drydock and a steel fabricating plant at Pensacola, Fla.

The project is being promoted by a group reported to include L. S. Wilder, former president of the New York Shipbuilding Corp.; Harvey Wiley Corbett, Harry T. Newcomb, vice-president of the D. & H. Railroad Corp., and Frederick H. Fay, engineer, Boston. The work is estimated to cost $30,000,000. An R.F.C. loan will be sought.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Chicago, June 27-30.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Chicago, June 26-30.

AMERICAN WATER WORKS ASSOCIATION, annual meeting, Chicago, June 12-16.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual convention, Chicago, June 26-28, 1933.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Chicago, June 27-30.

ENGINEERS WEEK, Century of Progress Exposition, Chicago, June 25-30.

THE NEW YORK SOCIETY OF THE PANAMA CANAL will hold its 9th annual banquet at the Hotel Astor, New York, during the evening of May 6.

AMERICAN IRON & STEEL INSTITUTE will hold its spring meeting at the Hotel Commodore, New York, during the morning and afternoon of May 25. The entire morning session will be given over to a discussion of the economic problems of the steel industry.

SEATTLE SECTION, American Society of Civil Engineers, at its meeting on April 24 was addressed by Homer Hadley on the subject of the Long Beach earthquake.

PACIFIC NORTHWEST SECTION, American Water Works Association, will hold its sixth annual meeting at Bellingham, Wash., May 11-13.

AMERICAN INSTITUTE OF QUANTITY SURVEYORS has elected F. F. Dischner, Detroit, president, to succeed the late Oscar Euphrat.

Personal Notes

CARL FORSBECK, formerly Tacoma representative of the Portland Cement Association, has been appointed city engineer to succeed C. E. PUTNAM.

CORNELIUS M. DAILY, a member of the Missouri Engineering & Contracting Co., has been appointed water commissioner of St. Louis. Mr. Daily was a division engineer in the water department for about 12 years under Edward E. Wall.

LINCOLN B. CHAMBERS, lieutenant-colonel, Corps of Engineers, now on duty with the 8th Engineers at Fort McIntosh, Texas, has been assigned to the engineering department of the Panama Canal and will go to the Canal Zone about Aug. 1.

ARTHUR M. SHAW, consulting engineer, Hangchow, China, has completed his engagements with the Chekiang Provincial and the Chinese National Governments and is reopening his office in New Orleans, for general and consulting service. He proposes to specialize in investigations and reports for investors and others regarding existing and prospective engineering projects in China and Latin America.

O. F. GOETZ, assistant engineer in charge of traffic, Tennessee Highway Department, has been named chief engineer of the department of succeed T. C. MCEWEN. Mr. Goetz is a graduate of the engineering school of the University of Tennessee and took post graduate work at Columbia University.

PHILIP HARRINGTON, principal assistant chief engineer, Sanitary District of Chicago, has been appointed chief engineer to fill the position left vacant by the resignation of Edward J. Kelly, when the latter was elected mayor of the City of Chicago. Practically Mr. Harrington's whole engineering career has been spent with the district as he went with the district following his graduation from Armour Institute of Technology in 1906. He is an electrical engineer.

HARRY B. TALBOT, THOMAS CLARKE and JOSEPH WEAVER, American engineers who are engaged in the construction of the vehicle tunnel under the Scheltz River at Antwerp, recently were honored by the Belgian Government for their service there. Mr. Talbot, construction superintendent, was made a knight of the Order of Leopold II, and Mr. Clarke and Mr. Weaver, who are assistant construction superintendents, received the Order of the Golden Palm and the Order of the Crown, respectively. The tunnel is being built under the direction of the engineering firm of Parsons, Klapp, Brickerhoff & Douglas, and of Ole Singstad, New York.

Obituary

ARTHUR LARRABEE, for the past 35 years an engineer in the Massachusetts highway department, died at his home in Lynn, Mass., April 28, at the age of 62.

DANIEL CAMPBELL, for many years an engineer and architect in the employ of New York City, died there on April 31, age 54 years. Since his retirement from city service in 1924 he practiced as a civil engineer in Flushing, New York.

D. FRANK LORD, for many years general manager of the Woodbury & Leighton Construction Co., and a former chairman of the National Safety Council, took his life at Worcester, Mass., April 27. He was prominent in engineering circles and had served on the governor's committee on street and highway safety in the Bay State. At the time of his death he was connected with the Matthew J. Whittall Associates, of Worcester.

PERRY ELLIS CARHART, retired chief inspecting engineer, Illinois Steel Co., died April 22 in Chicago. He was born in 1856 near Albany, N. Y., and was graduated from Union College, Schenectady, N. Y., in 1881. His early engineering experience was with the New York Central and Great Western railroads. He went to Chicago 44 years ago as chief inspecting engineer for the Union Steel Works which later became the Federal Steel Works and ultimately the Illinois Steel Company. All of which he served building up the inspection service from a one-man affair to its present elaborate staff from which he retired 10 years ago.

Brief News

DRAINAGE AND LEVEE DISTRICTS in Missouri may pledge their bonds as collateral for loans from the R.F.C. under a law recently approved by the governor of Missouri.

ALL NON-RESIDENT EMPLOYEES of the Missouri State Highway Department are being "released." No formal announcement of the department's policy has been made but it is believed to be the result of testimony brought out in a recent investigation of the highway department indicating that a considerable number of non-residents were employees of the department.

WATER RATES CANNOT BE MADE A LIEN against property, according to a decision of the Illinois State Supreme Court in the case of the Rockford Saving & Loan Association against the city of Rockford. The association came into possession of a piece of property against which the city had a bill of $14.15 for water. As the city refused to turn on water for the new tenant until the old bill was settled the association paid under protest and took the case to court.

PRINCIPAL AND INTEREST on road bonds of counties in New York State for the years 1933-34 and up to May, 1935, may be paid from the county's share of the motor fuel tax, up to 50 per cent of the amount received, under a law recently approved by the governor. At the time this law was approved the governor vetoed another bill authorizing counties to use such funds for bond interest payments permanently.

MOTOR VEHICLE REGISTRATION in the United States for 1932 amounted to 24,136,879, a decline of 6.6 per cent of the preceding year, according to figures compiled by the U. S. Bureau of Public Roads. Gross receipts from registration, permits, etc., amounted to $324,273,510. These funds were allocated as follows: State highways, $156,000,000; local roads, $76,000,000; payment on road bonds, $39,000,000; administration, $17,500,000; miscellaneous, $35,500,000.

A SANITARY DISTRICT for Onondaga County, New York, the county in which the city of Syracuse is located, has been created by an act recently passed by the New York state legislature. The district commission is to determine where sewer systems and sewage disposal plants are required, to fix benefit assessments and issue bonds to finance construction which are to be supported by a tax levy on the entire county. Charges for the use of sewers and sewer systems constructed by the district commission are authorized.

ADDITIONAL WELLS FOR WATER from underground sources in counties of Kings, Queens, Nassau and Suffolk on Long Island may not be sunk or operated by manufacturing or industrial concerns without the approval of the State Conservation Commission if the amount of water exceeds 100,000 g.p.d., under an amendment to the conservation law of the state recently approved by the governor.

Contracts and Capital

CONSTRUCTION
(Thousands of Dollars)

	Weekly May, 1932	Average Four Weeks	Week May 4 1933
Federal government	$6,530	$1,450	$778
State and municipal	13,160	15,433	46,380
Total public	$19,510	$16,883	$47,158
Total private	7,426	4,675	6,937
Week's total	$26,936	$21,558	$54,095
Cumulative to date			
1932		$398,721	
1933		317,327	

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

	Weekly Apr., 1932	Average Four Weeks	Week, Apr. 29, 1933
New capital issues	$11,500	$1,724	$2,795
Cumulative to date.			
1932		$295,000	
1933		75,781	
R.F.C. self-liquidating loans.			
Approved current week			$1,376
Approved to date (including 1932)			204,682
Actual loans made (including 1932)			20,458

ENR Cost and Volume Index

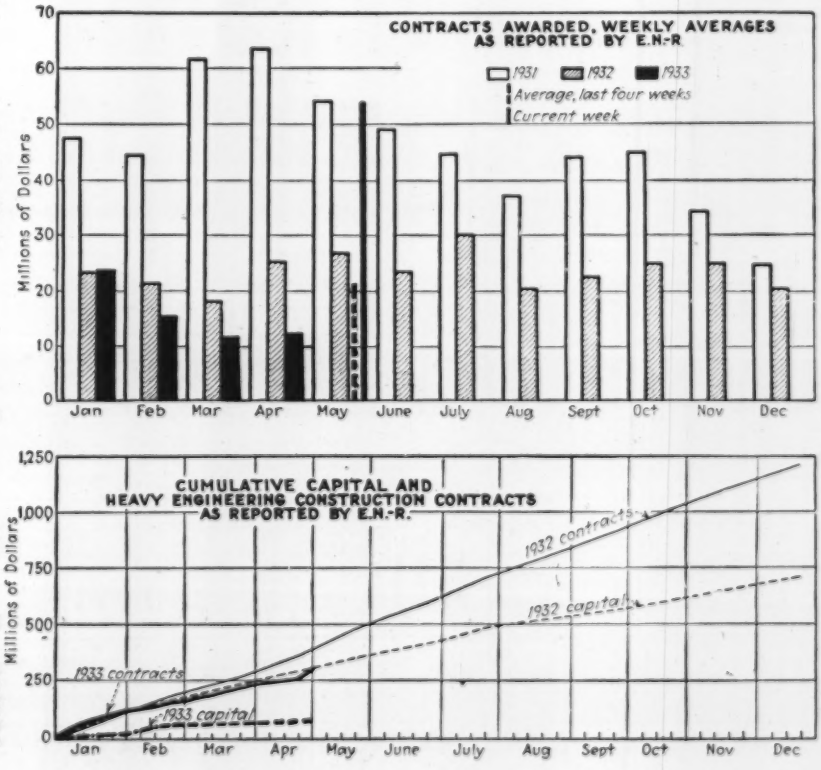
E.N.-R. Cost		E.N.-R. Volume	
May, 1933	**164.39**	**April, 1933**	**65**
April, 1933	160.16	March, 1933	62
May, 1932	152.78	April, 1932	135
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 Average	100		

Engineering Contracts and Capital

AWARD OF CONTRACTS aggregating 37 millions for the construction of the San Francisco-Oakland bridge, coupled with the letting of three tunnels on the Colorado River aqueduct, raised the total of contracts reported for the past week to $54,095,000, the highest weekly total reported since November, 1931. The three tunnel contracts amounted to $7,325,000. A heavy week in private contracts also helped the week's totals. This class of work amounted to $6,937,000, about 50 per cent greater than the average total of private contracts for the past few weeks. The strong showing of private contracts is due to a large number of brewery extensions and alterations. In the public works class, federal contracts remained low, amounting to only $778,000. The only federal contracts being awarded at present are those for which bids were called for before the announcement was made that no new work would be undertaken until a comprehensive public works program was adopted. Highway lettings held to the usual low figure, amounting to only $955,000, still feeling the effects of an uncertain federal highway aid program. Besides the bridge and tunnel contracts, another large award was reported, that for a power line in Ohio and Indiana to cost $1,500,000.

This week's large volume brings the average of contracts awarded the last four weeks up to $21,558,000. In May of last year contracts averaged $26,936,000 per week. Cumulative contracts to date this year total $317,327,000, as compared with $398,721,000 for a similar period last year.

New productive capital issues sold during the week amounted to $2,795,000, all public issues, of which $1,000,000 was a single issue of highway and bridge bonds sold by the state of Maine. The R.F.C. announced approval of three self-liquidating loans aggregating $1,376,200. Cumulative capital issues sold to date this year are falling far behind last year's total, to $75,781,000 as compared with $295,000,000.



Business Side of Construction

April Contracts Gain Over March; Materials Prices Rising

HEAVY ENGINEERING CONSTRUCTION contracts reported in April (four weeks) totaled $49,393,000 or $12,348,000 per week, as compared with $11,600,000 per week for March. During March contract awards suffered from the bank holiday, and the April volume was held down by the federal government's decree that no new contracts would be awarded until a public works program was decided upon. This decree likewise affected state and municipal awards, especially highway lettings which were postponed pending determination of the extent of federal aid. The month's weekly average of contracts is just about half of the $25,500,000 average of April, 1932. Cumulative contracts for the first four months of this year total $263,232,000, as compared with $371,375,000 for the same period of last year.

Public works contracts for April averaged 6.7 millions per week, a slight loss from the 6.9 million dollar average of March. Federal awards averaged on 1.7 millions per week, the lowest in years. Highway lettings also fell to a long-time low of 2.1 millions weekly. Private awards registered a gain from 4.7 millions per week in March to 5.7 millions in April.

Materials prices gain

The last of the month saw an increase in materials prices with lumber leading the way. Wholesale prices of lumber in New York jumped about $4, though retail prices have been slow to react in this territory. Increases in lumber prices were reported from many other sections of the country. Structural steel prices held firm, though hot rolled plates and galvanized sheets increased $2 per ton at Pittsburgh. Steel men hesitated to predict an increase in structural prices, though some are of the opinion an increased demand will react in an upward movement of all steel products. Cement prices have been steadily rising for nearly a year, though no marked increases were noted in April. The general rise in cement prices is causing consternation in some state legislatures when the highway departments report comparisons with last year's prices for the current year's requirements. Missouri, Illinois and Iowa legislatures are investigating the recent prices as well as the uniformity of cement bids being received. Illinois rejected two sets of uniform bids, averaging $1.62, for the year's supply, and then tried to lease a plant and produce its own cement. The cement companies stood in line and refused to consider a lease. Last year the state bought cement for 94c.

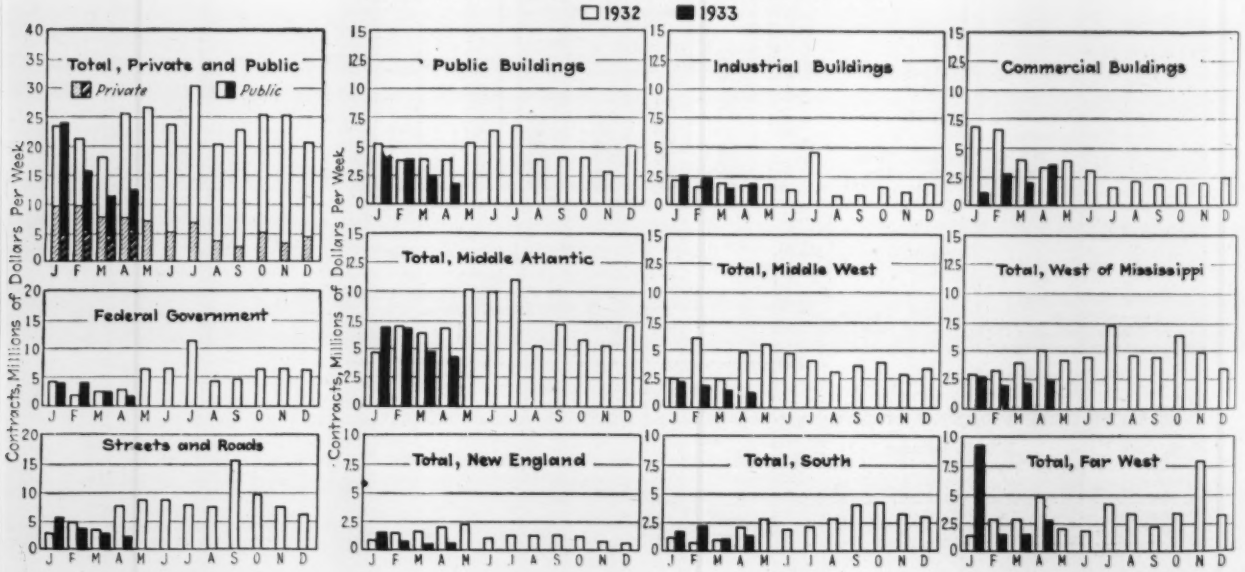
Clay products is another class of construction materials that is showing an upturn in prices. Sewer pipe, drain pipe and hollow tile all registered gains in prices in many distribution centers last month.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN APRIL, 1933

Four Weeks—Thousands of Dollars (000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States April, 1933	United States Four Months 1933	United States Four Months 1932	Canada April, 1932
Public Works										
Waterworks	108	320	32	666	532	4,612	6,270	31,099	8,543	5
Sewers	271	164	331	30	656	358	1,810	5,894	9,382	....
Bridges, public	20	116	81	60	93	409	779	10,463	17,040	2,600
Earthwork and waterways	55	50	55	255	626	11	1,052	19,931	13,931	....
Streets and roads	455	1,690	2,761	1,312	1,392	752	8,362	57,641	79,382	2,191
Buildings, public	168	553	887	24	4,920	789	7,341	49,465	70,258	125
Unclassified, public	148	206	27	62	190	418	1,051	2,956	22,997	192
Total public	1,225	3,099	4,174	2,409	8,409	7,349	26,665	177,449	221,533	5,113
Federal gov't (included in above classifications)	203	324	1,060	270	4,883	189	6,929	49,114	48,181	....
Private										
Bridges, private	....	77	1,079	25	10	.....	1,191	2,981	1,240	....
Buildings, industrial	793	2,798	318	1,704	525	1,265	7,403	33,779	31,247	333
Buildings, commercial	315	10,633	.....	531	11	574	12,064	36,897	86,806	220
Unclassified, private	67	142	.....	574	97	1,190	2,070	12,126	30,957	....
Total private	1,175	13,650	1,397	2,834	643	3,029	22,728	85,783	150,252	553
April, 1933 (4 weeks)	**2,400**	**16,747**	**5,571**	**5,243**	**9,052**	**10,378**	**49,393**	.....	.....	**5,666**
March, 1933 (5 weeks)	2,634	23,024	5,829	7,863	11,265	7,319	57,934	.....	.....	1,415
April, 1932 (4 weeks)	8,306	27,103	8,490	18,934	20,180	19,261	102,274	.....	.....	....
Four months, 1933	13,577	93,950	27,269	29,526	38,707	60,203	.....	263,232	.....	8,295
Four months, 1932	28,515	131,216	21,508	68,838	66,094	55,614	.....	.....	371,785	14,585

CONTRACTS REPORTED - WEEKLY AVERAGES - 1932-1933



Materials notes

Portland Cement—The portland cement industry in March produced 3,684,000 bbl., shipped 3,510,000 bbl. and had in stock at the end of the month 21,298,000 bbl., according to the U. S. Bureau of Mines. Production showed a decrease of 24 per cent and shipments a decrease of 11.7 per cent as compared with March, 1932. Stocks are now 22.7 per cent lower than a year ago. The ratio of production to capacity is rated at 16.1 for March, as compared with 13.4 for February and 21.3 for March, 1932.

Steel—A rise of over 100 per cent in the output of steel ingots during the month was the brightest spot in the materials field. Ingot production was rated at an average of 15 per cent of capacity for March by the American Iron & Steel Institute. At the first of April the output had fallen to 13 per cent. From then on increases were reported every week with the month closing at an estimated output of 29 per cent of capacity.

Lumber—Along with an increase in prices, the lumber industry enjoyed a considerable gain in volume of business. New orders reported by the National Lumber Manufacturers Assn. for the past month are as follows, in thousands of board feet: week ended April 1, 155,023; April 8, 137,673; April 15, 124,328; April 22, 135,843. Throughout the month orders and shipments were far in excess of production, following the industry's endeavor to reduce stocks on hand. New business is heaviest since last fall, and some weeks are heavier than any week of 1932. A number of logging mills and lumber camps have reopened in the Pacific Northwest during the past two weeks, putting hundreds of men to work.

Labor notes

Unemployment figures are slowly rising, though several localities report a decrease in the number out of work. Latest figures of the A. F. of L. place the number of unemployed in excess of 13 million in March, with about 27 per cent of union men out of work. Wages in the construction industry seem to be moving in two directions, skilled wages coming down while common wages are going up. In many places new agreements between skilled trades and employers show a downward revision, though usually regarded as temporary. On the other hand, states and municipalities are coming to the rescue of distressed common labor and are stipulating wages to be paid, at least on public construction, above the miserable rates which unemployed are willing to take.

Kansas City—All building trades scales have been revised downward with cuts ranging as high at 50c. per hour in the case of electricians, who will get $1 under the new scales. Building laborers took a 10c. cut to 60c. per hour. Other cuts average 12½c.

Massachusetts—Highway contractors in March employed 1,488 men, a decrease of 192 from the February total. The weekly wage per man during March averaged $25.48, or 59.5c. per hour. In February highway workers averaged $23.59 per week, or 56.8c. per hour worked.

St. Louis—Important contractors of the city are continuing to pay union building trades workers wages provided for under an agreement which expired April 15. The local contractors' association announced that no new agreement would be entered into and that after April 15 its members were free to set their own scales.

Washington—A reduction of $3 per day to $8 has been agreed to by master carpenters. The new agreement runs for one year.

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Cities	Bricklayers	Carpenters	Hoisting Engineers	Pile Drivers	Structural Iron Workers	Masons' Laborers	Common Laborers
Atlanta.....	$0.75@1.12½	$0.40@.90	$0.60@1.25	.....	$0.60@1.25	$0.25	$0.20@.25
Baltimore...	.50	.90	1.37	$0.65	1.25	.40	.30
Birmingham	.75@.87½	.60	.75	.....	.75	.25	.20@.30
Boston.....	.90@1.30	.60@1.17½	.90@1.17½	.70@1.07½	1.00@1.20	.45@.70	.35@.70
Cincinnati..	1.27½	1.02½	1.07½	1.07½	1.20	.70	.40@.45
Chicago....	1.37½	1.31¼	1.31¼	1.31¼	1.35	.88¾	.82½
Cleveland...	.90@1.37½	.75@1.12½	.90@1.12½	1.00	.90@1.06¼	.56¼	.30@.72
Dallas.....	.62½	.50	.50	.50	.50	.25	.25@.35
Denver.....	1.00@1.12½	.75@.87½	.75@.87½	.....	.75@.87½	.50	.31¼@.50
Detroit.....	.75@1.50	.55@.80	1.25	1.25	1.25	.70	.30@.50
Kansas City	1.30	1.00	1.00	1.06	1.00	.70	.60
Los Angeles.	.62½	.50	.75	.75	.75	.50	.35@.50
Minneapolis	.90@1.00	.75	.75	.....	.90	.50	.40@.50
New Orleans	1.00	.75	1.00	.70	1.25	.25@.40	.15@.25
New York..	1.50@1.65	1.25@1.40	1.50@1.65	1.50	1.65	.81¼@1.00	.50@.75
Philadelphia	.75@1.00	.50@.75	.75@1.00	.60@.75	.75@1.00	.20@.35	.15@.25
Pittsburgh..	.60@1.50	.60@1.25	.60@1.37½	1.00@1.18¾	.60@1.37½	.50	.40@.70
St. Louis...	1.50	1.25	1.35@1.47	1.25	1.47	1.00	.35@.78¾
San Francisco	1.12½	.90	1.00	1.00	1.20	.75	.65
Seattle.....	.75@1.20	.50@.90	1.00	.90	1.10	.66	.40@.50
Montreal...	.75	.60	.55	.....	.70	.45	.25@.30

Skilled Average (3 trades) $0.988 Common Average, $0.444

ENR Cost and Volume Index

The rising trend of construction materials prices, especially lumber, and a slight increase in common labor rates were sharply reflected in the *ENR* Construction Cost Index, which rose from 160.16 in April to 164.39 for May, the highest since December, 1931. The Index has increased almost six points since March. The trend of the Index has been distinctly upward since last June, when a 16-year low point of 152.20 was reached. The *ENR* Volume Index for April showed a slight increase, standing at 65 as compared with the previous month's low value of 62.

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May, 1933	**164.39**	**April, 1933**	**65**
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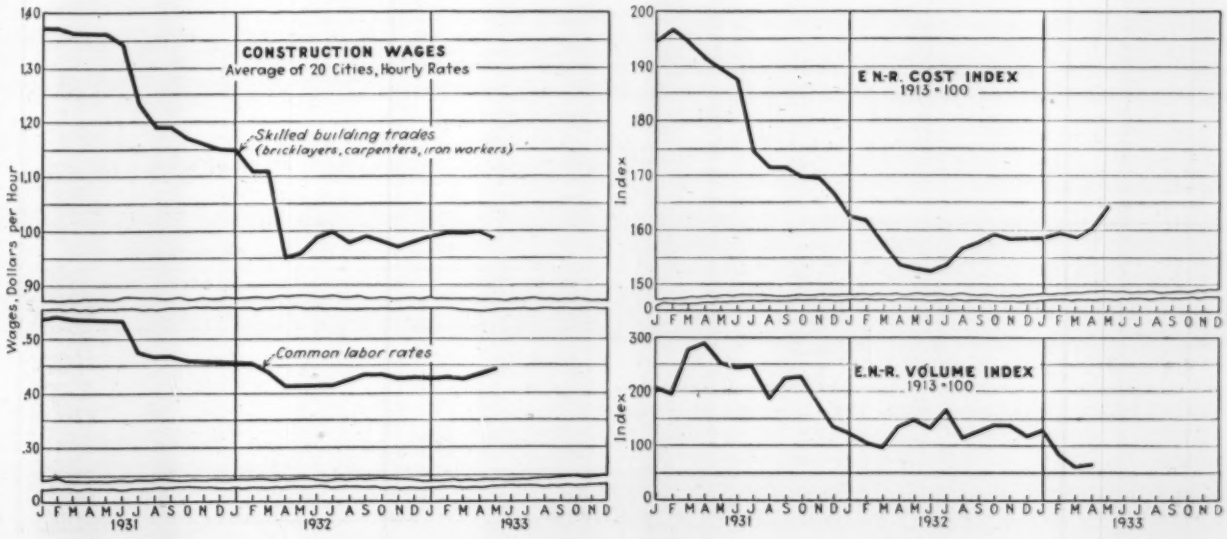

Current Prices of Construction Materials

Building Materials

PORTLAND CEMENT — Prices are for carload lots. For cement in returnable cloth bags add 40c. per bbl.; in non-returnable paper bags add 15c. per bbl., to following net prices:

	F.o.b.	Delivered		F.o.b.	Delivered
Atlanta	$2.35	$2.85	Kansas City	$1.75	$1.85
Baltimore	....	2.03	Los Angeles	2.10	....
Birmingham	2.00	2.10	Minneapolis	2.20	2.35
Boston	1.92	2.12	Montreal	1.70	....
Chicago	1.60	1.95	New Orleans	1.90	2.20
Cincinnati	2.31	2.46	New York	1.88	2.20
Cleveland	1.77	2.00	Philadelphia	1.94	2.04
Dallas	2.30	2.45	Pittsburgh	1.87	1.97
Denver	....	3.20	St. Louis	1.74	2.15
Detroit	1.90	2.05	San Francisco	2.05	....
			Seattle	2.55	2.70

Current mill-prices per barrel to dealers, for carloads of 132 barrels or over, without including charge for four bags, f.o.b. Bag charges same as in preceding table:

Alpena, Mich	$1.40	Mason City, Ia	$1.45
Buffington, Ind	1.35	Norfolk, Va	1.61
Dallas, Tex. (Inc. 5c. tax)	1.80	Northampton, Pa	1.40
Hannibal, Mo	1.35	North Birmingham, Ala	1.60
Hudson, N. Y	1.50	Richard City, Tenn	1.70
Independence, Kan	1.45	Saginaw, Mich	1.35
Ironton, Ohio	1.35	Steelton, Minn	1.55
Iola, Kan	1.45	Universal, Pa	1.40
La Salle, Ill	1.35	Waco, Tex	1.75
Limedale, Ind	1.35	Wyandotte, Mich	1.30

SAND AND GRAVEL — Per ton, carload lots, gravel, size ¾-in.:

	Gravel		Sand	
	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$1.95	$2.75	$1.50	$2.50
Baltimore	....	2.55	....	2.08
Birmingham, per cu.yd	....	3.00	....	2.40
Boston	1.40	1.65	.90	1.15
Chicago, per cu.yd	....	2.25	....	2.25
Cincinnati	1.20	1.65	.95	1.40
Cleveland	....	2.00	1.40	2.00
Dallas, per cu.yd	1.40	2.40	1.65	2.40
Denver, per cu.yd	1.75	1.85	1.15	1.20
Detroit	.50	1.45	.72	1.50
Kansas City (at plant)	.65	....	.50	....
Los Angeles	1.45	1.60	1.00	1.10
Minneapolis	....	1.60	....	.75
New Orleans	1.40	2.40*	1.20	2.00*
New York, per cu.yd	1.60	3.25	1.00	2.00
Philadelphia	....	1.66	....	1.38
Pittsburgh	....	1.20	....	1.40
St. Louis	.80	1.40	.80	1.25
San Francisco	1.65	....	1.65	....
Seattle, per cu.yd	1.75	....	1.75	....

*Cu.yd.

CRUSHED STONE — Per ton, size 1½-in., carload lots, limestone:

	F.o.b.	Delivered
Atlanta	$1.95	$2.75
Baltimore	....	2.60
Birmingham	.80	1.05
Boston	1.40	1.65
Chicago, per cu.yd, 2,500 lb	....	2.25
Cincinnati	1.65	1.85
Cleveland	....	2.00
Dallas, per cu.yd., 2,500 lb	1.65	3.00
Denver, granite, per cu.yd., 2,700 lb	....	2.50
Detroit	....	1.75
Kansas City (at plant)	1.00	....
Los Angeles	1.45	1.60
Minneapolis	....	1.60
New York, per cu.yd., 2,800@3,000 lb	1.65	3.25
Philadelphia	....	2.00
Pittsburgh	....	2.25
St. Louis	1.35	1.65
San Francisco, trap rock	....	1.65
Seattle, per cu.yd., 3,000 lb	1.10	....

CRUSHED SLAG—Prices for carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Slag Sand
Birmingham	$0.90	$1.15	$2.05	$0.55
Buffalo	1.35	1.35	1.85	1.25
Cleveland	1.70	1.70	....	1.35
Toledo	1.20	1.20	1.20	1.10
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown	1.10	1.20	2.00	.75

CONCRETE BLOCKS—Standard, 8x8x16-in., hollow, delivered to job, each:

Baltimore (8x12x12)	$0.20	Kansas City	$0.18
Birmingham (5x8x12)	.084	Los Angeles	.125
Boston	.14	Minneapolis	.10
Brooklyn and Queens	.09	Montreal	.12
Chicago	.175	New Orleans	.16
Cleveland	.165	Philadelphia	.15
Denver	.15	Pittsburgh	.18
Detroit	.09	St. Louis	.14

READY MIXED CONCRETE—Per cu.yd., 1:2:4, delivered 50 cu.yd. or more:

Atlanta	$7.75	Los Angeles	$5.40
Birmingham	5.00	Minneapolis	6.00
Boston	6.00	New Orleans	6.05
Cleveland	6.50	New York (Manhattan)	8.50
Cincinnati	5.95	Philadelphia	5.98
Dallas	7.00	Pittsburgh	6.05
Detroit 1:2½:5	4.75	St. Louis	6.80
Kansas City	7.50	Seattle	5.35

HOLLOW TILE—Building tile per block, delivered to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x1
Atlanta	$0.09	$0.11	$0.13	$0.20	$0.25
Baltimore	.10	.14	.20	.22	.30
Birmingham	.089	.122	.167	.219	.25
Boston	.0775	.1065	.1453	.1799	.208
Chicago	.0484	.063	.09	.1179	.13
Cincinnati	.06815	....	....	.165	....
Cleveland	.048	.066	.09	.117	.13
Dallas	.0455	....	....	.117	....
Denver	.085	.135	.175	.19	.25
Detroit	.0505	.065	.0947	.1175	.130
Kansas City	.0735	.092	.15	.1777	.207
Los Angeles	.09425	.134	.188	.2325	.311
Minneapolis	.0692	.0988	.1372	.1447	.202
New Orleans	.08	....	....	.22	....
New York	.075	.1164	.1455	....	....
Perth Amboy	....	....	....	.2388*	.295*
Philadelphia	.065	.093	.14	.175	.195
Pittsburgh	.0435	.065	.088	.1165	.126
St. Louis	.058	.082	.112	.155	.19
San Francisco	.0765	.105	.1765	....	....
Seattle	.085	.115	.18	....	....

*At plant. (Load-bearing tile).

BRICK — Prices per thousand in carload lots, as follows:

	Common Backing		Paving
	F.o.b.	Delivered	F.o.b. 3x8½x4-in.
Atlanta	$8.50	$14.00	$32.00
Baltimore	....	13.00	43.00†
Birmingham	10.00	12.50	25.00
Boston	11.50	13.00	35.00
Chicago	....	9.00	32.00
Cincinnati	13.50	16.00	36.50
Cleveland	12.00	14.00	33.00
Dallas	8.50	10.00	25.00†
Denver	13.00	....	40.00
Detroit	....	11.50	35.25
Kansas City	....	14.00	35.00
Los Angeles	8.50	....	....
Minneapolis	....	7.50	....
Montreal	21.25	....	....
New Orleans	11.00	14.00	40.00
New York	9.50	12.50	45.00
Philadelphia	....	13.00	40.00
Pittsburgh	11.00	13.00	35.00
St. Louis	....	11.00	32.50†
San Francisco	....	14.00	45.00*
Seattle	12.00	14.00	....

*2½x8½x4 in. †3½x8½x4 in.

LIME — Prices of hydrated, per ton, in paper; lump, per 180-lb. bbl., net:

	Hydrated				Common Lump,	
	Finishing		Common			
	F.o.b.	Delivered	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$13.50	$18.00	$11.50	$15.50	....	$2.50
Baltimore	....	20.00	....	13.00	....	....
Birmingham	21.00	....	12.00	....	$1.65	....
Boston	12.50	15.00	11.50	14.00	2.00*	2.75*
Chicago	....	20.00	....	14.00	....	2.75
Cincinnati	10.00	11.00	8.65	9.65	....	....
Cleveland	10.50	14.00	8.50	12.00	....	2.50
Dallas	....	20.00	....	....	....	2.75
Denver	....	30.00	....	22.00	....	2.85*
Detroit	9.25	14.00	7.25	12.00	....	....
Kansas City	.475‡	.50‡	....	.50‡	....	2.75
Los Angeles	24.00	26.00	17.00	18.00	....	2.00
Minneapolis	....	21.00	....	19.00	....	1.70
Montreal	....	....	12.00	13.00	....	....
New Orleans	13.50	21.00	11.00	14.00	1.66	1.95
New York	10.70	14.50	9.45	13.00	2.25*	3.15*
Philadelphia	11.50	15.39	9.90	13.49	....	1.18
Pittsburgh	10.70	12.20	9.95	11.45	1.85	2.35
St. Louis	....	.45‡	....	.40‡	....	2.75
San Francisco	19.00	....	19.00	....	1.59	....
Seattle	....	32.00	....	24.00	....	2.80

*Per 280-lb. bbl. (net.) ‡Per sack.

LIMESTONE—Mill blocks, f.o.b. siding, per cu.ft.:
New York:* Rustic buff, $1.38; Standard gray, $1.48; Standard buff, $1.5*; Selected gray, $1.58; Selected buff, $1.68; Variegated, $1.38.
Boston: Rustic buff, $1.47; Standard, $1.57; Selected buff, $1.67.
Pittsburgh: Rustic buff, $1.14; Standard, $1.24 at quarry; Selected buff, $1.34.
Philadelphia: Sel. buff, $1.59; Sel. gray, $1.49; Standard, $1.49; Standard gray, $1.39; Rustic buff, $1.39.
Atlanta: Standard $1.26.
*F.o.b. Bedford, freight allowed to N. Y.

SLATE—Roofing, f.o.b. quarry, Bangor, Pa., net, per square;

No. 1 Clear	$8.25@$9.50
No. 1 Ribbon	6.75@ 7.50
Medium Clear	7.25@ 8.00

Road and Paving Materials

PAVING STONE — Granite, lots of 50,000 blocks, 4x8x4-in., dressed, f.o.b. city:

Atlanta	$3.00 per sq.yd.
Baltimore	42.00 per M.
Birmingham (3½x8½x4-in.)	76.25 per M.
Boston	80.00 per M.
Chicago, 5 in	3.80 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	95.00 per M.
Dallas	25.00 per M.
Detroit, 5 in	2.80 per sq.yd.
Kansas City	2.75 per sq.yd.
Minneapolis, 4½ in	2.80 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in	135.00 per M.
Philadelphia, 4x10x5	115.00 per M.
Pittsburgh	115.00 per M.
St. Louis, 5 in	2.80 per sq.yd.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING — Prices f.o.b., in carload lots:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.00
Chicago	3½	12	1.90
Kansas City	3½	16	2.50
Minneapolis	2½	8	1.65
Montreal	3½	16	2.63
New York	3½	14	1.90
Philadelphia	3½	16	2.02
St. Louis	3½	16	2.00

CURBING—Per lin.ft., 5x16 in., straight, rough, f.o.b., in carload lots:

Atlanta	$0.41	Kansas City	$0.60
Birmingham	.50	New York	.65
Boston	.60	Philadelphia (6x20 dressed)	1.40
Dallas	.60	Pittsburgh	.80
Detroit	.45	St. Louis	.70

ASPHALT—Paving asphalt, f.o.b., per ton. Packages are 350-lb. bbl. or 425-lb. drums, in carload lots:

	Packages	Tank-car or -boat
Atlanta	$21.60	$17.40
Baltimore	19.00	15.00
Birmingham	.....	11.00
Boston	20.00	16.00
Chicago	22.50	15.50
Cincinnati (f.o.b. refinery)	18.00	14.00
Cleveland	18.00	14.00
Dallas	.....	27.00
Denver	27.50	.....
Detroit	16.80	12.43
Kansas City (f.o.b. refinery)	17.00	12.00
Los Angeles	18.50	12.50
Maurer, N. J. (Bermudez)	.....	26.00
Maurer, N. J. (Trinidad)	.....	22.00
Minneapolis (f.o.b. Twin Cities)	23.30	18.30
Montreal (f.o.b. factory)	18.66	13.00
New Orleans	17.00	13.00
New York	19.00	15.00
Philadelphia	17.00	11.00
Pittsburgh	25.00	16.00
St. Louis	21.70	17.70
San Francisco (f.o.b. refinery)	16.00	10.00
Seattle	21.10	16.00

LIQUID ASPHALT — Residual, hot application, f.o.b., in tank cars, 8,000 gal. minimum, per gal.:

Atlanta	$0.0689
Baltimore	.06
Birmingham	.06
Boston	.065
Cincinnati	.075
Dallas	.05
Kansas City	.05
Los Angeles	.05
Montreal at (refinery)	.09
New York	.06
Philadelphia	.08
Pittsburgh	.05
St. Louis	.07

EMULSIFIED ASPHALT — For penetration and surface treatment, per gal.:

Boston, applied	$0.14
Cincinnati, f.o.b. refinery	.06
Los Angeles, applied	.13
Des Moines, applied	.14
New York, applied	.15
Philadelphia, applied	.15
St. Louis, applied	.13
Seattle, f.o.b. refinery	.08

Iron and Steel

	Pittsburgh	Chicago	Birmingham
STRUCTURAL SHAPES AND PLATES, per 100 lb., base, carload lots	$1.60	$1.70	$1.75
CONCRETE REINFORCING BARS, ½ in., billet, per 100 lb., carload lots	1.40	1.65	1.75
SHEETS, per 100 lb., carload lots:			
Hot-rolled No. 10	1.40	1.65	1.70
Hot-rolled annealed No. 24	2.00	2.30	2.35
Galvanized No. 24	2.65	2.74	2.85
RIVETS per 100 lb., ½ in., structural, carload lots	2.25	2.35	2.30
SHEETPILING, per 100 lb., base, carload lots	1.90	2.05	.....
WIRE NAILS, per 100 lb., base, carload lots	1.85	2.05	2.30
HEAVY MELTING STEEL SCRAP, No. 1, per gross ton, at consuming point	10.25	6.75	7@7.50

TRIANGLE MESH—Plain, per 100 sq.ft., in carload lots:

Style Number	Size, In.	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mill
032	4x4	22	$0.85	$0.86
049	4x4	28	1.07	1.10
068	4x4	35	1.30	1.34
093	4x4	45	1.68	1.72
126	4x4	57	2.08	2.13
153	4x4	68	2.47	2.54
180	4x4	78	2.84	2.92
245	4x4	103	3.75	3.84
287	4x4	119	4.34	4.35
336	4x4	138	5.03	5.16
395	4x4	160	5.83	5.98
036P	4x8	17	.64	.66
053P	4x8	24	.91	.93

TRIANGLE MESH—*Continued*

Style Number	Size, In.	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mill
072P	4x8	31	1.14	1.17
097P	4x8	40	1.48	1.51
049R	4x8	24	.91	.93
067R	4x8	31	1.14	1.17
089R	4x8	40	1.48	1.51

WIRE ROPE—Discounts from manufacturers' list prices on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	25 %
Galvanized iron rigging and guy rope (add to list)	7½ %
Galvanized steel rigging and guy rope	12½ %
Plow steel round strand rope	40 %
"Special Steel" and extra strong cast steel, round strand rope	32½ %

Discount 5 points less than discount for Eastern territory: California, Colorado, Kansas, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Texas, Washington and Wyoming. Discount 10 points less than discount for Eastern territory: Arizona, Idaho, Montana and Utah.

EXPANDED METAL LATH—Per 100 sq.yd., painted, f.o.b., in carload lots 2.2 lb. per sq.yd., standard-mesh diamond lath:

Atlanta	$12.50	Los Angeles	$17.00
Birmingham	17.00	Montreal (2.5 lb.)	24.00
Boston	15.00	New Orleans	20.00
Chicago	10.60	New York	13.50
Cincinnati	11.00	Philadelphia	13.50
Dallas	16.00	Pittsburgh	13.50
Detroit	18.00*	St. Louis	19.00*
Kansas City	17.00*	San Francisco	17.00*
*Delivered.		Seattle	17.00

STEEL FREIGHT RATES — Per 100 lb., effective Dec. 3, 1931, on finished steel products in the Pittsburgh District, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc.; 40,000 lb. per car:

Atlanta, 36,000 lb.	$0.60	Detroit	$0.285
Baltimore	.29	Kansas City	.59
Birmingham	.60	New Orleans, 36,000 lb.	.69
Boston	.42	New York, 40,000 lb.	.35
Buffalo	.255	Pacific Coast, 60,000 lb.	1.17*
Chicago	.36	Philadelphia	.31
Cincinnati	.285	St. Louis	.41
Cleveland	.205	St. Paul	.60
Denver	.92	* All rail.	

Railway Materials and Supplies

STEEL RAILS — Per gross ton, f.o.b.

	Pittsburgh	Birmingham	Chicago
Standard rails	$40.00	$40.00	$40.00
Light rails	30.00	32.00	30.00
Re-rolled rails	26.00	.....	27.00

RAILWAY TIES — Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In by 8½ Ft.
Boston	Oak, untreated	$0.90	.....
	Pine, untreated	.85	.....
	Pine, creosoted	1.40	.....
New York	Long-leaf sap pine, untreated	.80	$1.00
	Mixed oak, untreated	....	1.00
Birmingham	White oak, untreated	.75	.95
	White oak, creosoted	1.35	1.45
	Southern pine, untreated	.35	.80
	Southern pine, creosoted	.95	1.35
Chicago	White oak, untreated	1.05	1.35
	Oak, empty cell, creosoted	1.40	1.80
	Oak, zinc treated	1.25	1.65
	Southern pine, creosoted	1.15	1.50
Los Angeles	Fir, untreated	.45	....
	Fir, creosoted	1.15	....
Philadelphia	Red oak, untreated	.95	1.15
	Red oak, creosoted	1.47	1.90
St. Louis	White oak, untreated	.85	1.30
	Red oak, untreated	.75	1.20
	Red oak, creosoted	1.12	1.70
	Sap pine or cypress, untreated	.65	1.00
San Francisco	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	1.00	1.00
	Birch or maple, creosoted	1.25	1.55

TRACK SUPPLIES — Prices per 100 lb., f.o.b., for carload lots:

	Pittsburgh	Birmingham	Chicago
Angle bars	$2.55	$2.55	$2.25
Standard spikes	2.15	2.40	2.60
Tie plates	1.75	1.85	1.85
Track bolts	3.50	3.50	3.50

Pipe

WROUGHT STEEL PIPE — Discounts from standard list for delivery from warehouse, except at Pittsburgh, where prices are f.o.b. mill. List prices per ft. as follows: 1-in., 17c.; 3-in., 76½c.; 3½-in., 92c.; 6-in., $1.92.

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Atlanta	44%	36.5%	42%	34%
Chicago	57.25%	44.71%	53.83%	41.29%
Cleveland	53.3%	42.3%	50.8%	37.8%
Denver	44.5%	32%	41%	28.5%
New York	56.14%	43.6%	52.72%	40.18%
Philadelphia	57.28%	44.68%	53.68%	41.80%
Pittsburgh	64%	52.5%	61%	49.5%
St. Louis	60.64%	49.84%	58.84%	48.04%

Current Prices of Construction Materials

Pipe—Continued

CAST-IRON PIPE — Prices per net ton, for bell and spigot pipe, Class B and heavier, f.o.b. in carload lots; gas pipe and Class A, $3.00 per ton extra:

	4-In.	6-In. and Over
Atlanta	$37.50	$34.50
Boston	41.00	38.00
Birmingham (Base)	33.00	30.00
Burlington (Base)	35.00	32.00
Chicago	41.50	38.50
Dallas	45.50	42.50
Los Angeles	41.50	38.50
New York	38.50	35.50
Philadelphia (rail delivery)	36.50	33.50
Pittsburgh	41.50	38.50
St. Louis	40.50	37.50
San Francisco	41.50	38.50

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.135	$0.21	$0.385	.....	$1.40.	.....	.....
Baltimore	.10	.30	.58	.....	1.93	.....	$6.50
Birmingham	.18	.30	.54	$1.02	1.95	$3.50	5.00
Boston	.135	.21	.405	1.325	2.385	4.68	7.175
Chicago	.18	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.0945	.....	.2835	.....	1.125	2.448	.....
Cleveland	.135	.21	.405	1.125	2.025	4.824	7.38
Dallas	.236	.....	.7165	.....	2.70	.....	.....
Denver	.16	.23	.414	.816	1.44	.....	.....
Detroit	.15	.25	.48	1.125	2.025	3.80	.....
Kansas City	.21	.335	.52	1.00	1.90	3.80	.....
Los Angeles(f.o.b.)	.2175	.2825	.5085	1.1865	2.034	3.69	.....
Minneapolis	.15	.21	.415	.95	1.72	2.85	3.75
Montreal	.30	.45	.75	1.95	2.60	.....	7.20
New Orleans	.16	.....	.51	.....	1.90	.....	.....
New York	.1665	.259	.4995	1.325	2.385	.....	.....
Philadelphia	.081	.126	.243	.65	1.17	2.376	4.615
Pittsburgh	.09	.18	.27	.62	1.22	2.45	3.68
St. Louis	.09	.205	.369	.945	1.62	3.20	4.44
San Francisco	.175	.25	.45	1.05	1.80	3.00	4.50
Seattle	.175	.275	.54	1.20	2.00	3.00	5.50

CLAY DRAIN TILE—Per 1,000 lin.ft., f.o.b., in carload lots, 4 in.:

Atlanta	$50.00	Los Angeles	$60.00
Birmingham	50.00	New Orleans	40.00
Boston	50.00	New York	35.00
Chicago	40.00	Philadelphia	36.00
Dallas	65.00	Pittsburgh	80.00
Denver	75.00	St. Louis	40.00
Detroit	50.00	San Francisco	67.50
Kansas City	60.00	Seattle	45.00

Miscellaneous

LINSEED OIL—Raw, in 5-bbl. lots, per lb., f.o.b.:

Atlanta (per gal.)	$0.79	Minneapolis	$0.094
Birmingham	.066	Montreal (per gal.)	.49
Boston (per gal. delivered)	.65	New York	.086
Dallas (per gal.)	.555	Philadelphia	.075
Denver	.11	Seattle (per gal.)	.69
Kansas City (per gal.)	.64	St. Louis	.099
Los Angeles	.0946	San Francisco (del)	.1125

WHITE LEAD—In oil, per 100 lb. keg., f.o.b.:

Atlanta	$12.50	Montreal	$ 9.54
Birmingham	12.50	New Orleans	11.00
Boston	11.00	New York	11.00
Dallas	12.00	Philadelphia	9.90
Kansas City	11.13	Seattle	11.50
Los Angeles	11.25	St. Louis	11.00

CHEMICALS—Water, sewage treatment, road work, f.o.b., carlots, New York:

Bleaching powder, in drums, f.o.b. works, per 100 lb.	$1.75@2.00
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competion, per ton	19.50
Chlorine, cylinders, per lb. delivered	.05½
Silicate of soda, in drums, f.o.b. works, per 100 lb.	1.65
Soda ash, 58%, in bags, per 100 lb.	1.22½
Sulphate of aluminum, in bags, per 100 lb.	1.25@1.40
Sulphate of copper, in bbl., per 100 lb.	3.00

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ¼-in., 6-ft.; ½-in., 4-ft., 5-in.; ¾-in., 3-ft., 8-in.; 1-in., 2½-ft., 2-ft., 5-in.; 1¼-in., 1-ft., 8-in. Following prices are per lb. for ¼-in. and larger, delivered in 1,200 ft. coils:

Atlanta	$0.1575	Kansas City	$0.20
Baltimore	.225	Los Angeles	.1725
Birmingham	.20	Minneapolis (f.o.b.)	.155
Boston	.13	Montreal	.14
Chicago	.175	New Orleans	.17
Cincinnati (f.o.b.)	.21	New York	.145
Cleveland	.21	Philadelphia	.15
Dallas	.18	St. Louis	.145
Denver	.165	San Francisco	.145
Detroit	.19	Seattle	.155

BUILDING PAPER—Black, 50-lb. per roll of 500 sq.ft., in carloads, f.o.b., producing point $2.10

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.60

PREPARED ROOFING—Per square, f.o.b., in carload lots:

	Single Shingles*	Strip Shingles†	Rolls‡
Atlanta	$5.00	$5.35	$1.75
Boston	5.76	3.18	1.41
Dallas	4.50	3.75	1.75
Detroit	6.25	6.50	1.85
Montreal	6.40	6.20	2.68
New Orleans	5.60	5.50	2.00
New York	6.50	6.25	2.50
Philadelphia	4.40	4.20	1.65
Seattle	8.75	5.50	2.25
St. Louis	5.76	4.76	1.41

*Slate finish, sufficient to cover 100 sq.ft. ‡Slate surfaced, in rolls weighing 85 to 90 lb. †4 in 1, hexagonal shape, with Underwriters' label

ROOFING MATERIALS—In carload lots, f.o.b.:

	Asphalt Felt, per 100 Lb.	Tar Felt, per 100 Lb.	Asphalt Coating, per Gal.	Tar Pitch,* per Ton
Atlanta	$44.50†	$44.50†	$0.45	$44.50
Boston	2.40	2.40	.50	23.00
Dallas	2.75	2.75	.65	34.00
Denver	2.00	2.00	.90	18.00
Montreal	2.62‡	2.02‡	1.40	1.63**
New Orleans	.....	2.50	.....	22.50
New York	2.40	2.40	.34½	28.00
Philadelphia	2.25	2.25	.33	20.00
Seattle	2.40	2.40	.55	27.90
St. Louis	2.52	....	2.95	26.00

*In 350 lb. barrels. †Per ton. ‡Per roll. **Per English cwt.

WINDOW GLASS—Discounts from latest jobbers list, dated Sept. 15, 1928 for sizes above first three brackets:

	Single Thickness		Double Thickness	
	A Quality	B Quality	A Quality	B Quality
Atlanta	85%	85%	85%	85%
Birmingham	89%	91%	89%	91%
Boston	88%	90%	87%	89%
Dallas	85%	85%	85%	85%
Denver	84@5%	86@5%	84@5%	86@5%
Kansas City	90@10%	90@10%	90@10%	90@10%
New York	87%	89%	87%	89%
Philadelphia	88%	90%	88%	90%
Pittsburgh	90%	90%	90%	90%
Seattle	90@10%	90@20%	90@10%	90@20%

EXPLOSIVES—Price per pound for dynamite delivered:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.215	$0.2375	Los Angeles†	$0.1725	$0.1925
Baltimore	.21	.255	Minneapolis	.1725	.1875
Birmingham	.13	.1525	Montreal	.1675	.1925
Boston	.245	.27	New Orleans	.19	.22
Chicago	.17	.195	New York	.245	.2675
Cincinnati (f.o.b.)	.22	.245	Philadelphia	.215	.24
Dallas	.2125	.2475	St. Louis	.1375	.1525
Denver	.19*	.21*	San Francisco	.1575	.1825
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

*F.o.b Louviers. †F.o.b. arsenal.

Lumber

LUMBER—Per M. ft., b.m., No. 1, Common, rough, in carload lots:

SOUTHERN YELLOW PINE

	1 x 6 In.*		1 x 8 In.*		3 x 12 In.†		12 x12 In.†
	F.o.b.	Del.	F.o.b.	Del.	F.o.b.	Del.	F.o.b
Atlanta	$14.00	.....	$15.00	.....	$35.00	.....	$45.00
Baltimore	.....	$46.00	.....	$43.00	.....	$42.00	35.00
Birmingham	18.00	20.00	18.00	20.00	20.00	22.00	30.00
Boston	24.00	29.00	25.00	30.00	57.00	62.00	57.00
Chicago	.....	.....	.....	.....	.....	62.50	.....
Cincinnati	.....	28.00	.....	28.00	.....	35.00	35.00
Cleveland	30.00	38.00	32.00	40.00	46.00	54.00	.....
Dallas	.....	35.00	.....	35.00	.....	50.00	52.50
Denver	.....	31.00	.....	33.00	.....	44.00	50.00
Detroit	30.00	32.00	30.00	32.00	32.00	32.00	45.00
Kansas City	30.00	.....	25.00	.....	47.50	.....	50.00
Minneapolis	.....	31.00	.....	31.00	.....	34.00	.....
Montreal	44.00	.....	45.00	.....	30.00	.....	.....
New Orleans	.....	18.00	.....	19.00	.....	30.00	.....
New York	22.00	24.00	23.00	25.00	50.00	52.50	50.00
Phil. No. 2(com.)	18.00	22.00	19.00	23.00	26.00	30.00	44.00
Pittsburgh	20.00	28.00	20.00	28.00	26.00	36.00	44.00
St. Louis	22.50	27.50	22.50	27.50	42.50	47.50	41.00

DOUGLAS FIR

	1 x 6 In.*		1 x 8 In.*		3 x 12 In.†		12 x12 In.†
	F.o.b.	Del.	F.o.b.	Del.	F.o.b.	Del.	F.o.b.
Baltimore	.....	$48.00	.....	$52.00	.....	$58.50	.....
Boston	$21.00	26.00	$21.00	26.00	$30.00	35.00	$35.00
Chicago	.....	.....	.....	.....	.....	44.52	.....
Cincinnati	.....	.....	.....	.....	.....	42.50	42.50
Cleveland	30.00	38.00	32.00	40.00	40.00	54.00	.....
Denver	31.00	.....	33.00	.....	46.00	.....	50.00
Detroit	.....	.....	.....	.....	30.00	30.00	45.00
Kansas City	29.00	.....	32.00	.....	38.00	.....	42.00
Minneapolis	.....	31.00	.....	31.50	.....	36.00	.....
New Orleans	.....	21.00	.....	21.00	.....	42.50	.....
New York	19.00	21.00	20.00	22.00	22.50	24.50	24.00
Philadelphia	.....	.....	.....	.....	.....	28.00	30.00
Pittsburgh	.....	.....	.....	.....	30.00	44.00	30.00
St. Louis	29.00	34.00	29.00	34.00	31.50	36.50	31.50
San Francisco	.....	17.00	.....	18.00	.....	19.00	19.00
Seattle	9.00	10.00	9.00	10.00	11.00	12.00	12.00

*Form lumber, 16 ft. lengths. †Planks and timbers, 20 ft. lengths.

PILES—Prices of Nichols Bros., 90 West St., N.Y.C., per linear foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.09	$0.145
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.13	.195
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.15	.215
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.185	.225
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2025	.225
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.265	.375
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.305	.442